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French Firm Develops Advanced 3D Thermoforming Composite Textile

91WS0292A Paris INDUSTRIES ET TECHNIQUES in French 8 Mar 91 pp 63-64

[Article by Michel Le Toullec: "Composites: 3D Textile Structures"]

[Text] Silac Chaignaud, the king of felt for slippers, could well revolutionize the technical textiles industry. This company (420 million francs in annual revenue, with 950 employees) based near Angouleme, has recently patented a completely original technique for manufacturing 3-dimensional composite textiles.

Three-dimensional [3D] textile structures have existed for some time. Generally speaking, they consist of layers of textiles (woven, nonwoven, or knit reinforcing fibers) superposed and inserted in a layer of polymer (the matrix). Products of this type, lightweight and mechanically very strong, are already being used in the automobile and aeronautics sectors. But their use poses problems, particularly as regards cost—in that, the different thicknesses of material must be layered manually—but also as regards delamination. Moreover, these structures do not really lend themselves to complex shapes.

The Silac Chaignaud approach is doubly original: First, because for its 3D structure it uses threads that are already composites to begin with—threads made of a crisscross of short polymer-matrix fibers with synthetic, glass, or other reinforcing fibers, and second, because these threads are spun in the form of a 3D structure in a single operation. Schematically, this produces a multilayered fabric whose thicknesses (generally up to six) are bonded by a network of perpendicular threads that are also composites. A highly complex structure that Chaignaud produces on very slightly modified conventional looms. The result is a dense, homogeneous weave that is entirely formable in three dimensions, and that therefore can be molded to fit relatively complex shapes. The product is among the simplest to use, since it can be applied cold, in bulk, to the mold, then thermoformed. It can also be used to manufacture components requiring a variable degree of compaction and containing rigid elements. Another advantage is that different types of fibers can be combined to produce a multiple-use composite. For example, by interweaving threads containing glass reinforcement and metal reinforcement, a structure could be produced that is both mechanically strong and capable of being used as a heat shield...

Fabrication of the Reinforcing Elements of Structural Components

With this process, Silac Chaignaud is aiming at a definitive penetration of the automobile sector, even though its sales in this sector are already approximately the equal of those in its traditional sector, namely, footwear. "These 3-dimensional textiles are currently aimed first of all at the upholstery and interior appointments niche, particularly the interiors of vehicle doors and vehicle instrument panels," says Jacques Baudonnel, the company's head of technical textiles. "For instrument panels, the material could replace plastics. This would eliminate the problem of fogging (release of plasticizing agents under the action of heat and their deposition on windshields and windows), a problem that is very difficult to overcome with a polymer." But the company is also counting on 3D composite textiles to penetrate other markets, such as household electrical appliances and leisure-time equipment (particularly, speaker systems). "To say nothing of aeronautics," says Jacques Baudonnel. "The technique lends itself to fabrication of the reinforcing elements of structural components." In this case, these 3D structures would be made 100 percent of reinforcing fibers such as carbon or Kevlar, and not of composite fibers as heretofore, and would be impregnated with thermosetting resins, using present-day techniques.

French Laboratory Products Reach Industrial Applications Stage

91WS0298B Paris INDUSTRIES ET TECHNIQUES in French 22 Mar 91 pp 36-38

[Article by Michel Le Toullec: "Materials: Nancy, Crucible of Transfer"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] Materials research at Nancy—specializing in structural products—is wide open to industry. Its two CRITT (Regional Centers for Innovation and Technology Transfer) clearly show this, as much for their work on quasi-crystals or stereolithography.

At Nancy, technology transfer and materials go firmly hand in hand. The city is in effect the crucible for two CRITT in the field of structural materials, one dedicated to metals, the other to plastics and composites. It is an ideal structure for bringing together industry and the dozen Nancy university laboratories that comprise (in addition to the Metz groups) the Lorraine Institute of Materials (ILM).

Titanium Alloys, the Strong Point of LSGMM (Laboratory for Science and Engineering of Metallic Materials)

One of the mainstays of this ensemble is the LSGMM, headed by Andre Simon, who is also presides of the ILM. "Ninety percent of the work of the laboratory is carried out in cooperation with industry," he announces at the outset. "I must say that our activities are particularly condicive to it, since they range from the development and transformation of materials to their working." As an example, the laboratory is credited with the development of quasi-crystals of aluminum/copper/iron alloy.

The brief history of quasi-crystals is worth retelling. Long considered laboratory curiosities, they were useds on kitchen utensils, thanks to the shrewdness of one of

the researchers. Quasi-crystals are known to experts for their symmetry on the order of five (they are composed of elementary "bricks" with pentagonal facets), which was long considered impossible. But until Jean-Marie Dubois took an interest in them in 1985, no one had seen any real value to them except as laboratory curiosities. And there were certainly no industrial opportunity.... However, one day the researcher was contacted by a Lorraine firm, France Grignotage, which was looking for a way to increase the service life of its cookware coatings. It happened that these quasi-crystals have the characteristic of being good, highly heat conductorive, nonsticking, and very resistant to temperature and abrasion, all at the same time. Then, they seem an alternative to cast-iron, which "sticks hard" and is difficult to heat, and to Teflon, which scratches easily. All that had to be done was to develop a process for projecting microparticles quasi-crystal. This was done onto the aluminum in collaboration with the New Industrial Metallization Company (SNMI). France Grignotage is now ready to advance to the product marketing phase.

The study of titanium alloys is another strong point of the laboratory. LSGMM belongs to a scientific group that includes Cezus, Snecma, Aerospatiale, Turbomeca, and C3F, as well as other research laboratories. The program involves beta CEZ, a titanium alloy was developed by Cezus (of the Pechiney group) for applications around 400°C in aircraft engines or some compressor parts. This alloy is a "strategic" material because it is being considered in particular for the M88 engine of the Rafale [French fighter]. LSGMM's part in the program includes simulation of the behavior of the alloy during its manufacture and utilization, and the optimization of its mechanical properties through thermomechanical treatment.

Similarly, the team also recently undertook a ceramics effort based on a very old technique, mechanical alloying. The principle consists of finely grading a mixture of materials and obtaining not only smaller particles, but also a new product through the action of the released energy. In particular, a patent has been drafted for the manufacture of aluminum/metal cermets from a mixture of metallic oxide and aluminum. The particular target market is cutting tools.

The laboratory is also a member of CRITT Metal 2T (with other groups in Nancy and in Metz), a center headedr by one of its researchers, Jean-Marie Schissler. Opened two years ago, this CRITT's credits already include some national projects (in partnership with ANVAR [National Agency fo the Upgrading of Research], the Ministry of Research, and AFME [French Energy Management Agency]) and a Brite Euram program, in addition to its service offerings and its regional feasibility studies. The objective of Brite Euram, a three-year European project, is to optimize the service life of ceramics used in metal-castings facilities. This is a very ambitious project, in collaboration with INPL and the firms of Unimetal, Didier Werke and ERPI—in a very large market, where the Americans and the Japanese are already competing.

For two years now, Nancy has also had a CRITT specializeing in plastic materials and composites: Apollor. The center is presided over by Christian G'Sell, research director of the laboratory of physical metallurgy and materials science (MPSM). One of the missions of this laboratory (shared by the School of Mines and Nancy) is to model the behavior of these materials, a topic which may appear far afield for industry, but which turns out to be very practical. It is expected to enable better mastering of the manufacturing process and troublr shooting in case the piece breaks. "At this time we are developing some rules for the behavior of composites of the TRE (pressable reinforced thermoplastics) type within Apollor, in cooperation with PSA," Christian G'Sell explains. The manufacturer uses this process to make the base support for the 405 and certain ventilator supports. The two-year-old study under a grant from CIFRE has led to a model of the flow of the material and the behavior of the fibers at the time of manufacture. The next step is to determine a rule for the behavior of the gas captured in the material during pressinh." Along the same lines, the group recently studied the behavior of a polyurethane on some of Essilor's optical glasses and the deformation of some mixtures of PMMA-based (polymethyl methacrylate) polymers for Norsolor. These original measurements were refined mainly on some equipmeny produced at MPSM; they now developing this equipment for others in the Apollor program. An example is the real-time systems for tracking deformation and cracking of materials, designed for Atochem.

For its part, since 1982 ENSIC (National Higher School for Chemical Industries) in Nancy has been one of the top groups working on stereolithography, a development unfortunately halted by the quantity of patents filed by the American firm Spectra Physics, the first to commercialize such a system. This makes it possible to manufacture of prototype pieces without having to make a mold. It is done by successively depositing layers of a photosensitive resin which hardens under the action of a laser. Everything is connected to a 3-D computer-assisted design (CAD) model of the piece in question. Far from being discouraged, the group is continuing its work with help from Renault, Peugeot, EDF (French Electric Utility), and Marcel Dassault Aircraft. One of its assets is fine-tuning the resins most resistant to deformation—one of the snags in the current system. This is a trick tha' could enable the group to breach the American near-monopoly.

[Box, p 37]

Materials and Process Engineering

If chemistry is the science of reactions between substances, then chemical engineering means putting those reactions into operation. How could you expect a science

that studies agitation and diffusion to confine itself to well-defined boundaries? Thus, chemical engineering, which has been renamed process engineering by circumstance, now is turning to biotechnologies, energy and ... materials. In Nancy its secular arm, the first French focus on the subject, is called LSGC (Laboratory of Sciences of Chemical Engineering). Its work on materials includes conductive polymers and their reaction to electromagnetic fields, in collaboration with Hoechst, DuPont, ONERA (National Officer for Aerospace Studies and Research), and DRET (Directorate of Technical Research and Studies). "But there is still a lot left to do on traditional polymers like polystyrene, acrylics, and their copolymerization. In fact a strong relationship has been noted between the manufacturing process and the final properties of the material," says Andre Laurent, Director of the ENSIC, which hosts much of the LSGC. This work is done by firms like Rhone-Poulenc or Atochem, but there is close coordination with the other organizations in Nancy, especially the School of Mines.

Under study is the creation of an industrial department of complex fluid engineering, for the purpose of making it an internationally recognized center of competence. Any fluid whose laws of behavior are unknown is called complex. In fact, this includes most of the fluids which industry handles every day, from yoghurt to the polymers that melt in passing through drilling mud. Already supported by Rhone-Poulenc, Atochem, Lafarge Coppee, Total Chemical, and Michelin, the department is expected to receive a million francs from industry, plus a contribution from the CNRS (National Scientific Research Center). There remains the task of finding the professor to run it.

AEROSPACE

ESA Inaugurates Earth Observation Coordination Center

91WS0333A Paris AFP SCIENCES in French 18 Apr 91 p 13

[Text] Paris—The European Space Agency's (ESA) Center for the Coordination of Payload Data for Earth Observation Missions was inaugurated 12 April in Frascati, near Rome, by the ESA's general director Jean-Marie Luton. The announcement was made by the ESA in a communique received in Rome.

The center was also inaugurated by the state undersecretary to Learco Saporito, the Italian minister of universities and scientific research. It is housed in the European Institute for Space Research (ESRIN). All the "ground sector" activities of the first European Earth observation satellite—the ERS-1, which is scheduled to be launched by Ariane on 3 May—will be planned and prepared there.

With its hyperfrequency radar instruments capable of penetrating clouds and darkness, the ERS-1 will be able to furnish a whole set of valuable data on our planet and environment. The ESA stresses, however, that the important part of an Earth observation mission is not the satellite itself, but the information that is collected on the ground.

The "ground sector," which is responsible for receiving and processing this information and communicating it to users, therefore plays a crucial role in the success of the mission. For the ERS-1 and later missions (ERS-2 followed by a series of polar platforms), the task has been entrusted for several years now to ESRIN, within the framework of the European Earthnet Program.

Germany Determined To Stay Course With Hermes, Columbus

91WS0246A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 14 Mar 91 p 8

[Unattributed article: "Space Flight Projects Hermes and Columbus Remain Controversial"]

[Text] Despite considerable misgivings, the opposition in the Bundestag will probably not refuse German participation in the planned European manned space flight projects, as long as their cost remains within the outlined framework. This was the outcome of a technical meeting of the Friedrich-Ebert Foundation on the topic of "Controversial Space Flight" in Bonn. But the governing parties are having a hard time holding on to the Hermes and Columbus projects because of the enormous budget strains of the German unification and the Gulf war. One way out of the current financial straits could be to delay these projects by about two to three years, which also seems sensible in view of the technical problems which have developed for Hermes and Columbus.

Professor Reimar Luest, former director of the European Space Agency (ESA), referred to the international involvement in the field of astronautics and the obligations which Germany assumed in 1987 at the ministerial meeting for the manned space flight projects Hermes and Columbus. Furthermore, Luest emphasized the economic feasibility of the Ariane-5 rocket, the scientific usefulness of the Columbus space station and the technical necessity of the Hermes orbital glider for the participating European countries, and particularly German industry. Dr. Erhard Keppler of the Max-Planck-Institute for Aeronomy, who is known as an opponent of manned space flight, takes the opposite point of view. Keppler fears that purely scientific studies using satellites and space probes, as well as other research disciplines, will suffer. Keppler doubts that orbital microgravity research will bring commercially useful results one day. "In any event, we don't need expensive manned missions, that can also be determined by correspondingly programmed robots," the scientist believes.

The participants in the meeting discussed the technical, financial, political and even military aspects of the European and German space flight participation in five

separate working groups. The conclusion arrived at was that the politicians are now increasingly using technical arguments and diplomatic considerations to justify to the friendly nations that major manned space flight projects should be kept, because the scientific-commercial applications of Columbus and Hermes will only occur much later than originally anticipated—if ever.

Despite major budget problems and serious bottlenecks in research funding, the Federal Government wants to keep the manned space flight projects agreed on within the European network, stressed Dr. Dietmar Frenzel of the German Space Agency, since legal contracts which involve them have been concluded and so as not to strain political relations with France and the United States.

But these ambitious European space plans are still in doubt because of various technical problems with the Hermes orbital glider and with the U.S. space station, on which the European Columbus project essentially depends. If the weight problems of the small orbital glider cannot be solved, a more powerful version of the Ariane-5 rocket must be developed, which would entail considerable additional costs, however. That would constitute both a reason and a legal justification not only for Germany to pull out of this project, which the French want to hang on to at all costs.

The situation is different for the Columbus space station, which essentially depends on the concept of the Freedom Platform dominated by an international group of nations and the United States. This project involves serious changes and reductions in capacity, which will not have any effect on the coupling of the European Columbus module, according to what NASA says. "The European space station is primarily supported by the German side, which wants to use it to expand its lead in microgravity research," explains Prof. Walter Kroell of the German Aerospace Research Institute.

As considerable as the sums of 8.8 German marks [DM] and 7.4 billion for building Hermes and Columbus appear, in international comparisons the European and German space spending is modest, as Prof. Harry Ruppe of the Munich Technical University made clear. The roughly 7,000 specialists working on space projects in the FRG represent only 0.25 per thousand of all employees, but they produce more than 1 per thousand of the gross social product. With approximately DM2 billion, Germany is responsible for only 2.2 percent of the total spending for astronautics in the world. And with Columbus and Hermes only about 30 percent of that money is used for manned projects. "But new forms of financing these major space projects are necessary for our continued cooperation, projects in which industry must also become involved to a greater degree," demands undersecretary Riedl.

Germany: Reservations About Space Expenditures Focus on Hermes

91WS0262A Duesseldorf VDI NACHRICHTEN in German 15 Mar 91 p 3

[Article by Wolfgang Mock: "Tight Money Determines Policy"]

[Text] With a hint at German unification and the costs of the Gulf War, the West German Federal Government is asking its European partners to extend the joint space projects. There are, of course, some indications in its financial planning that it might even have more in mind: getting out of at least one of the big manned space travel projects.

"Anyone who believes in space travel must also go along with increased net borrowing." These are strong words in difficult times. What Erich Riedl, aviation and space travel coordinator, demanded last week at a space seminar of the Friedrich Ebert Foundation in Bonn, did earn him the applause of the assembled representatives from industry but got him hardly more than a shrug from the politicians. German unity and the war in the Gulf have caused money to be in short supply and that applies above all to space travel.

But the pressure to make a decision keeps growing. Just recently, European industry submitted to ESA, the European Space Agency, its concept and general finance plan outline for the Hermes space glider; a decision is to be made after a long delay, late in autumn, by a conference of ESA ministers. Right now, of course, there is every indication that the Federal Government is getting ready to pull out of this project.

Just three years ago, the situation looked entirely different. Federal Research Minister Heinz Riesenhuber thought that it was "irresponsible" if we did not want to use "the future options of manned space travel." But this option lost is attractiveness as the costs for the German unit kept rising. As early as in the middle of last year, the Federal Government decided to cut to 25.3 billion German marks [DM], the DM30 billion that originally had been earmarked by the year 2000 for German and European space travel activities, above all the ESA programs for the Ariane 5 booster, the Hermes space glider, and the Columbus space laboratory. "We could have been comfortable with that," said Wolfgang Wild, head of DARA, the German Space Agency for Space Affairs.

But certainly no more than that. For the past two years, there has been a relentless savings and stretch-out drive in the space program, mostly at the expense of the domestic program parts. Because it was impossible to save enough here, the European programs must now also be tapped, most likely the Hermes space glider that is under French system management. In this case, "time and cost planning" as well as "technical feasibility"—according to a study by the German Aviation and Space

Research Institute of last November—"still contain considerable uncertainty." Besides, the study continues, "the flyability of the Hermes configuration over the entire speed range continues to be critical." Thus it would seem that the Hermes "compromise solution" at any rate "will soon necessitate the development of a new and more efficient follow-on system."

During a meeting Santa Margherita, in Italy, early in February, Wild also tried to convince his European colleagues first of all to build an unmanned version of Hermes and to postpone development of system components, such as the survival system and the ejectable survival seats. According to his plans, the space glider would not make a manned flight in 1998, as planned originally, but only in the year 2005. Besides, the representatives of the ESA member countries were to make their final decision on the construction of a manned Hermes and an Ariane 5 with increased thrust only in 1996.

But the German delegation was alone in holding such views. Joerg Feustel-Buechl, who is responsible for space transport systems at ESA, believes that such a concept "is technically not doable. Besides, you cannot save any money that way. We would have two separate developments then." The German space industry views the situation in the same fashion.

By way of a compromise, the ESA representatives in Italy agreed, therefore, to stick to the old concept but to shift the first Hermes takeoff to the year 2001, a stretch-out that would cut the annual costs by 10.4 percent.

Barely back from the South, Wild found himself facing new difficulties: the Federal Government submitted its medium-term financial plan. According to it, funds for space travel were to increase only by an average of 3 percent until 1994. But an increase by almost 12 percent would be necessary to meet the minimum requirements arising from national and international obligations. This means that the stretch-out becomes a kind of tilt. Back in June 1990, the Secretary of State for Space Travel already realized clearly that the "deletion of a major project" was unavoidable in view of such poor increase rates.

Klaus Berge, DARA business manager for infrastructure, and Wolfgang Grillo, the business manager in charge of commercial matters, agreed with Wild that, on this basis, all blueprints for a new space program, including Ariane 5, Hermes, and Columbus, would turn into nothing but "waste paper." This year alone, there will be a shortfall of between DM100 and DM300 million for the implementation of the planned space projects and, by the year 2000, that amount would probably be as much as DM10 billion.

The Federal Research Ministry is at this very moment already putting the brakes on the outflow of additional funds for Hermes to industry. "We are having problems," warned Manfred Hollstein, the chief of the space main sector at Dornier, "in holding our teams together."

If the Federal Government sticks to its current plans, then, according to Hollstein's calculation, the space industry would lose 20 percent of its jobs.

In view of these massive financial problems, the opposition has also called for an effort to rethink the space travel objectives. "Arguing only with financial difficulties," in the opinion of SPD [Social Democratic Party of Germany] Deputy Wolf-Michael Catenhusen, would be "fatal. There has to be some content here also." The SPD likewise feels that the biggest problems rest with Hermes.

Bonn is still hopeful in the matter of space travel and is waiting for the next budget. But there is one fact that even Riedl did not want to dismiss last week: Everything that is below the planning estimate of DM25.3 billion for space travel until the year 2000 "is the beginning of the dropout from manned space travel."

A340 Being Prepared for October Rollout

91WS0270A Stuttgart FLUG REVUE in German Mar 91 p 47-49

[Article by Volker K. Thomalla: "Air Transport: First A340 in Final Assembly—Countdown to First Flight"]

[Text] The dual program Airbus A330/A340 is obviously making progress. The first prototype is currently in the final assembly stage in Toulouse, while preparations for the production run are underway. After the maiden flight this year, approval is expected for 1992.

In ornithology, commercial flights would count among the bird species that leave their nest very early. Once they have hatched, they mature very rapidly. Therefore, the first Airbus A340 whose roll-out is planned for October, will not be on the ground in Toulouse-Colomiers for very long; it will take to the air the very same month. Extensive testing procedures will follow and approval by the European aviation authorities is expected to come slightly less than a year later so that the airlines can place the aircraft in service as soon as possible.

Officially, the A330/A340 program started as a dual program in 1987. With the four-jet A340 and the two-jet A330 Airbus Industrie wants to enter the market for big long-range airplanes which has been the exclusive domain of U.S. manufacturers. The A330 and A340 models are designed for different tasks which complement each other. Divided into three classes, the A340-200 has a seating capacity of 262, a range of 14,000 km (7,650 nm) and a maximum take-off weight of 235.5 tons. The fuel tanks hold 135,000 liters of kerosine. The airplane's weight empty is 118,000 kg. The -300 Version has room for 295 passengers and a maximum range of 12,500 km (6,750 nm). In terms of weight, the -300 version differs from the A340-200 only with regard to its weight empty which will be 121,000 kg.

The A330 differs from the A340 only in the number of jet engines and the engine installations. Fuselage, wings,

tail plane and on-board systems are identical. With 63.66 m, the A340-300 is slightly more than 4 meters longer than the A340-200 which will be 59.39 m long. The distance between the wingtips which are equipped with winglets will be 60.30 m for both models. The two-jet engine A330 with a seating capacity of 335 is 85 percent identical to the A340, its four-jet counterpart, which make things considerably easier for the airlines in terms of crew training, maintenance and spare parts supplies. With 335 passengers including luggage it has a range of 8,800 km (4,750 nm). The new Airbus models will be equipped with modern two-man cockpits with sidesticks which proved to be very effective in the A320. A modified version of the A320's fly-by-wire system will be used in the A330/340. Crews who are certified for the A320 can be retrained for the new models in a relatively short period of time.

The A340 will be the first of the two models to be completed. The A330 is expected to take to the air 12 months later, in the second half of 1992. The fact that both models are so similar will help the A330 to obtain speedy EROPS approval since the A340 will have clocked 50,000 hours of scheduled flying time by the time the A330 is put into service. Most of the experience gained with the A340 systems can be applied directly to the A330.

The Aerospatiale plant in Colomiers which was built specifically for the final assembly of the A330/340 is currently getting busy. The big empty space of the "Clement Ader" hall, one of the largest buildings in Europe, is buzzing with activity. The plan is to assemble seven A330/340 per month in this plant starting in the mid-nineties. The German Airbus plans to deliver seven assembly sets by the end of 1991, 22 in 1992, 50 in 1993 and 74 in 1994.

Super Guppy To Deliver Parts From All Over Europe

The individual fuselage segments and other components for the final assembly of the A340 are gradually arriving in Toulouse-Colomiers: In late November a Super Guppy delivered the front fuselage including the cockpit section to Colomiers. The center fuselage section was delivered a few days later from Saint-Nazaire. In the middle of December, the fully equipped wings, each about 30 m longs, were flown in from Bremen. The Spanish Airbus partner CASA [Aeronautic Constructions Company] delivered the horizontal tail unit by truck in early January, and on 18 Jan, DASA [Deutsche Aerospace] head Juergen E. Schrempp in Hamburg sent the first tail end of the A340 fuselage on its way to the South of France.

In the South of France, the A340 prototype is taking shape. Final assembly is organized in such a way that the various fuselage sections and wings are assembled in a final assembly line as usual. However, wing assembly, system checks and final check-out will take place in a dock so that the airplane does not have to be moved from one station to the next.

The wings are positioned using a computer-controlled frame at the center section of the fuselage. Eight robots will be drilling the 3,500 fastening holes into this section. The use of robots speeds assembly by ten percent. Never before in the history of airplane construction has automatic machinery been used so extensively in the joining of wings and fuselage. However, when it comes to positioning and fastening the connecting bolts, Airbus Industrie does not rely on the computer; they are positioned manually by the workers. The individual fuselage sections are being riveted by automatic riveting machines.

The rudder unit made of CFRP [carbon fiber reinforced plastic] is manufactured by the plastics center of the German Airbus in Stade. It arrived at the final assembly hall in late January. According to plan, the A340 prototype will stand on its wheels for the first time on 8 Mar, the first power-on tests of the electrical systems are planned for 12 Mar. In April, CFM International will deliver the four CFM56-5C2 jet engines. They have a thrust of 31.200 pounds (140 kN) each and are the most powerful version of the CFM56 line. The first unit was already in the air: It has been in flight tests under the wing of a Boeing 707 since late August. In November, Airbus Industrie signed a contract with CFM International for the development of an even more powerful CFM56 version. Starting in 1995, this version with a thrust of 32.500 pounds (145 kN) will allow the A340 to take off with more weight. This means that it will have a longer range or a higher load capacity.

Vibration tests on the first 340 are will start in June 1991. Different from the previous Airbus models, the cabin equipment will be installed at the same location where the final assembly takes place. This saves time and money, since the flights between the final assembly line in the South of France and final equipment installation in Hamburg will no longer be necessary.

Static strength tests on the front fuselage sections will start at the "Centre d'Esais Aeronautiques de Toulouse" (CEAT) in the summer of 1991. The fuselage center section of the fracture cell was transported by truck from the Aerospatiale plant in Colomiers right through the town to the CEAT. Tests with the fracture cell will continue even after official approval has been granted. They will continue until the cell breaks.

In February, 1992, the Industrieanalage-Betriebsgesellschaft (IAGB) in Ottobrunn will start the fatigue tests which are required for approval of the two new Airbus airplanes A330 and A340. As part of the 80 million German marks program, the A340 will be subjected to the simulated stress of 40,000 flights, for the A330 45,000 flights will be simulated. The center section of the fuselage which is 31 m long and the wings with a length of 59 m will be pounded by servohydraulic cylinders for four years with three shifts per day. After these four years, the cell will be dismantled and inspected.

One Simulator For Two Airbus Models

While assembly of the first A340 is moving forward, Aeroformation in Toulouse is making preparations for training the first A340 crews and maintenance personnel. The training concept which is largely based on experience gained with the A320 crew training was presented to representatives of A340 customers and the aeronautic authorities at a conference on crew training in Toulouse. Since the A330 and A340 cockpits are very similar, one simulator can be used to train the crews for both aircraft. The screens which display the engine data are identical. When the simulator is used to simulate the A330 instead of the A340, only the instrument panel section which contains the thrust levers has to be exchanged.

Airbus Industrie expects to sell about 1,300 A330/340 airplanes in the next 18 months and to increase its commercial aircraft market share from 35 to 40 percent. So far, 28 customers have signed 411 purchasing commitments; 220 of these are firm orders. Since the largest airplanes are the usually most profitable ones for the manufacturer, Airbus Industrie managing director Jean Pierson said at a press conference in Paris in January: "As to the further development of our product program, near-term priority will be given to developing a stretched version of the A330 and A340."

AUTOMOTIVE INDUSTRY

Computer-Assisted Maintenance Increases Peugeot Productivity

91WS0337 Paris TECHNIQUES & EQUIPEMENTS DE PRODUCTION in French Apr 91 p 18

[Article signed L.V.: "A Maintenance Project for the Peugeot Group"; first paragraph is TECHNIQUES & EQUIPEMENTS DE PRODUCTION introduction]

[Text] With the so-called MAO, its computer-assisted maintenance software, Peugeot is launching a large-scale project.

The decision to launch a computer-assisted maintenance project was made by the Peugeot industrial committee in 1988. "The maintenance people claimed they could no longer work with paper," Maurice Christot, project leader at the production management department of Peugeot Automobiles, explained. In a first stage, a few commercial software programs were selected, but they would have required the development of specific applications. Peugeot therefore felt that a single in-house system was warranted, especially as the maintenance data of its production centers had never been computerized.

Eventually, 40 Sites

Nearly all plants adopted a machine-availability approach, and the project was the result of a will to improve productivity. "The machines are supposed to work at 100-percent capacity, but they work only at 70 percent," Maurice Christot, went on. "Failures account for 10 percent of the losses, and we must improve that by 5 percent. Translated in number of cars produced, that represents quite a large sum." The project, simply called MAO, is also partially linked to the company's right-flow policy. In a sheetmetal plant, for instance, downtimes are not allowed to exceed seven minutes.

The new software program will be located in the workshop, between management-oriented systems (materials management, exclusive of manufacturing, and maintenance time management) on the one hand, and local systems (production and installation-supervision monitoring), command and control (application program interface) and production tools on the other hand. The software program will consist of 15 or so functional modules, ranging from planning to corrective-action follow-up, and including lists, production schedules, costs, the computing of indicators, documentation, etc.

The application uses an Oracle relational database and runs on a HP computer under Unix; it is portable under IBM-VM.

Once operational, MAO will not necessarily be systematically installed at all of the group's sites. "We do not wish to impose the system. It is essential that users should be motivated." User plants will have to draw up an economic balance sheet in order to get the software program, but they will not have to pay for it. Eventually, some 40 sites should use it. Maurice Christot emphasized that MAO is designed for users at all level. "It is an aid to the maintenance function that production line managers could also use. We are therefore talking about a large population, on the order of 30,000 for the corrective-action module for instance."

Most of the software program, whose total development time is estimated at 3,500 man/days, should be ready by the end of the year. Seventeen people, working in three groups (data processing, designing jointly with users, information/training), are working full-time on the project. As far as training is concerned, proper understanding of the programs and modules is tested through a "user-friendliness laboratory." Maintenance agents are given practice exercises; they are observed without their knowing it, by engineers who can then, if need be, modify their documentation to make it easier to understand.

Three modules—documentation catalog, catalog and list of corrective-action points—are already operational at nine pilot sites, five at Peugeot (Dijon, Sept-Fond, Poissy, and two in Mulhouse) and four at Citroen (Tremery, Borny, Aulnay and Vigo). They represent the first of the three start-up stages of MAO, whose integration has been scheduled in predefined stages. "For these first three modules, we define standards, we codify, we draw up lists of symptoms for each machine," Maurice Christot indicated.

This approach will make it possible to establish connections between the causes and remedies of failures, and to create reliability databases. Eventually, Peugeot wants machine suppliers to be able to deliver documentation (Amdec, lists). This approach is in line with both Peugeot and Citroen's efforts to define maintainability criteria, for instance concerning maximum assembly and disassembly times for machine parts.

Renault Studying Auto Parts Recycling

91WS0274A Paris AFP SCIENCES in French 28 Feb 91 pp 45-46

[Text] Paris—The two million junkheaps that end up in the wrecking yard each year are a big problem for automakers. So the companies, often flatly accused of contributing significantly to the degradation of the environment, are embarking on sweeping and expensive research programs, on all fronts.

Renault, for instance, currently employs nearly 1,000 people and spends more than 800 million French francs [Fr] a year trying to develop "clean" engines, less polluting motor fuels, and safer and quieter cars. "The environment," says Mr. Paul Percie du Sert, the company's environmental policy representative, "has come of age at Renault."

The problem of wrecks is especially difficult as the destroyed vehicles, which average 10 years in age, were built at a time when the care taken to protect the environment was not what it is today.

It is true, stresses Mr. Percie du Sert, that 75 percent of a vehicle is composed of metal, whose recovery today is part of a well-oiled circuit. But that leaves 25 percent of the components, such as plastics, rubber, and minerals, unrecycled. They represent an annual mass of nearly 400,000 metric tons, which will have to be disposed of in the future somewhere besides dumps.

For metals Renault has managed, without sacrificing optimal quality, to recycle 85 percent of aluminum alloys, 30 percent of steels, 100 percent of cast iron pieces, and 70 percent of battery lead. Today a Clio contains at least 30 percent recycled metal. Furthermore, Renault reconditions engines in its Choisy-le-Roi factory and recycles most of the used oil collected from its dealers and agents.

But the solution for the future, Mr. Percie du Sert emphasizes, is to create new and reusable materials for all nonmetal vehicle parts. The parts will have to be easy to disassemble, which means recycling will have to be taken into account at the vehicle design stage. They will also have to be easily identifiable, and Renault-Volvo are now collaborating with Peugeot Ltd. on defining a joint marking or identification standard.

The inside panels of Clios and Renault-19s are already manufactured from recycled materials and this trend, according to Mr. Percie du Sert, will grow to other recycled materials and other models in the future. Likewise, the many plastic components of the next Renault Espace will all be marked and thus identifiable.

At the same time, Renault has just set up a pilot center to disassemble wrecked cars in its Flins factory: notably to study the stripping and disassembly times of different kinds of wrecks. Renault's research directorate, in partnership with the Cibie Company, is also preparing a study on industrial disassembly and how to optimize the crushing of wrecks.

German-Norwegian Research Promotes Aluminum Use in Automobiles

91WS0267A Frankfurt/Main FRANKFURTER ALLGEMEINE in German 26 Feb 91 p 22

[Unattributed article: "Norwegians Want More Aluminum in the Automobile—In the Future, Norsk Hydro Will Coordinate the Division From Munich—Lower Weight Versus Higher Cost"]

[Text] To increase the use of aluminum in the automobile, Norsk Hydro a.s., Oslo, the largest Norwegian industrial group, established the Hydro Aluminium Automotive GmbH near Munich last fall. The Munich company which is associated with Norsk Hydro Deutschland GmbH, Duesseldorf, will initially have a staff of 30 and will be the international marketing and controlling center for aluminum in the automobile. According to Ivar Hafsett, chief executive officer of the Swiss company Hydro Aluminium Extrusion S.A., Lausanne, which is responsible for aluminum, the ambitious goal is to become the leading European supplier of extruded aluminum parts and systems for the automotive industry. According to Hydro, DM80 million will be invested. Extruders are used to push mouldings made of material which can be shaped when heated (thermoplastic material) through nozzles. The "automotive group" of Norsk Hydro which is active on the international market includes four aluminum plants in the U.S., one plant for automotive wheels (Fundo) in Norway, one aluminum profile plant in Toender along the Danish-German border as well as one plant in Nenzing (Voralberg) in Austria.

The automotive industry has been studying the possibility of increasing the use of aluminum in various projects for some time; however, so far these studies have not led to a break-through for this light alloy. Occasionally, doubts are raised as to the advantages of aluminum; however a more important reason is the high cost of the raw material compared to steel. According to Norsk Hydro, aluminum is three times more expensive. Hans-Georg Mangold, a member of the managing board of the Swiss group who is responsible for the Munich company admits that this is one of the crucial issues. Even in the long run, aluminum will not be cheaper than steel.

One important advantage mentioned is the possible reduction in weight resulting in greater fuel efficiency

The group has an in-house research program called "Aluminum Space Frame" which tries to reduce the weight of the car body by 40 percent. In addition, aluminum can be reused quite easily. Scrap aluminum can be processed for reuse with lower energy costs and a 90 percent yield. In addition, the group claims that aluminum has advantages in the safety area. With optimum adjustment of design and alloy the so-called crumple zone effect could be even more pronounced than with conventional steel plates.

The company expects positive results from the joint development which is part of the European scientific program Eureka. Completion of this development project is expected for 1992. The company hopes for proof that the number of individual assembly components can be reduced, that investments in general as well as overhead costs for inventories can be lowered and that the automotive industry can change models more quickly due to improved assembly and module control. The argument is that this will become more important as the industry competes with Japan and the U.S.

Until now, Hydro Aluminium has been selling approximately 26,000 tonnes of aluminum products to the automotive industry per year. According to company data, the group produces 630,000 tonnes of raw aluminum per year which makes it Europe's largest aluminum producer. Mr. Mangold who previously held top management positions at Quelle, Karstadt and Masco Corp., a U.S. company, is convinced that deliveries to the automotive industry could grow at an annual rate of at least 10 to 15 percent. He believes that the use of aluminium in automobile production can be increased twofold or even threefold. Today, each vehicle uses between 50 and 70 kg of aluminum. Mr. Mangold considers an increase to 150 kg within ten years a realistic figure. In addition, he quotes even more optimistic estimates according to which a figure of more than 270 kg per vehicle is considered possible by the turn of the century.

Norsk Hydro

The Norwegian group Norsk Hydro was founded in 1905. Its first products were fertilizers for agriculture. Since then, other divisions for light alloys, petrochemistry, biotechnology, crude oil and natural gas have been added. The company claims to have the largest crude oil and natural gas reserves in Europe. Recently, Norsk Hydro expanded into East Germany by taking over the Rostock Fertilizer Plant (F.A.Z., 11 Jan). In 1989, the Norwegian group had a workforce of 33,000 and sales of approximately DM17 billion. Figures for 1990 are not yet available. The Norwegian government owns 51 percent of the company, the remaining capital is widely held and traded at stock exchanges.

BIOTECHNOLOGY

EC Commission Approves Easing of Genetic Research Restrictions

91WS0360A Hamburg DER SPIEGEL in German 22 Apr 91 pp 262-263

[Article: "Loosening the Bonds"; first paragraph is DER SPIEGEL introduction]

[Text] EC commissioner Martin Bangemann enters the lists as a "trailblazer" for biotechnology. Europeans are to become a world power in genetic engineering.

His face wreathed in gloom, the corpulent EC politician appeared before the press last Thursday in Strassbourg. His topic was the impending collapse of European biotechnology. But the predicted downfall is not going to occur—thanks to Bangemann.

On the previous day the German EC commissioner for internal affairs, together with his Italian colleague Fillipo Maria Pandolfi, had pushed through the EC commission an internal strategy paper that outlines the political course which the West is to move into the genetically engineering future.

In its 18 pages the policy paper bemoans the tottering competitiveness and the "wretched image" of European gene technicians. There is danger in delay; the EC is losing its share in a development which promises "such positive effects on our daily lives."

The document calls for energetic support for research and development of new biotechnology procedures. "Diffuse" anxieties among the population are to be dispelled by an ambitious public image campaign. It is vital that Communitywide information networks on gene technology be built up without delay. In Bangemann's opinion, every reasonable politician must serve as "facilitator and trailblazer" for the homunculus trade.

Currently there are about 800 businesses working in the area of genetic engineering in the EC, 1000 in the U.S. and 300 in Japan. According to Bangemann, as early as the year 2000 the "key technology of the future" will have created approximately "2 million jobs." There is no way to avoid fiddling with one's inheritance, quite the reverse: "Branches of the economy which ignore this new knowledge will be destroyed by the competition."

Biotechnology is still in its infancy, but the avalanche of genetic engineering seems unstoppable:

- The agrochemical industry is already testing pesticide-resistant potatoes, sugar beets and tobacco plants. Genetic botanists are trying to make plants resistant to salt and drought or to redesign them in such a way that they can absorb nitrogen from the air as it is emitted by fertilizers. In Great Britain, the chemical conglomerate ICI is waiting for the introduction of genetically engineered tomatoes which do not become mushy.

- The pharmaceutical industry is holding out the prospect of a whole flood of wonder drugs. Already available are genetically engineered insulin, the medication TPA (Tissue Plasminogen Activator) to dissolve blood clots, and the compound Factor VIII, a clotting agent for patients with blood diseases.
- The food industry is examining the advantages of genetic manipulation of cheese and bread. In Switzerland, France, and the Netherlands, the use of genetically manipulated rennin (chymosin) for cheese curdling is permitted. British bakers are raising baked goods with yeast from the genetic blender.

Bangemann, an EC market economist, fears that Europe will soon fall behind in these promising developments. European biotechnology, fettered by innumerable regulations, must currently deal with "significantly higher costs"; the "attraction of Europe as a site" is at risk. But the German commissioner vows to help. "The Community is making every effort to put no unnecessary hurdles in the path of industry."

The EC now wants to help in protecting intellectual property in the biotechnical sector too. First the term of patent protection is to be extended, so that the industry can sell its artificial organisms more profitably. In addition, engineered life forms—previously excluded—can also be protected. Farmers and breeders will have to pay money for cloned plants or useful animals which have been genetically optimized.

Even the "Fourth Criterion" demanded by the EC parliament is swept aside the table by the strategy paper. This guideline is intended to take the "socio-economic effects" into account in the licensing of genetic engineering products. In that case, the "turbo-cow" hormone BST, for example, would never have reached the marketplace. The hormone injection causes cows' udders to swell and increases milk production by up to 25 percent. If BST were to become accepted, the EC's milk lakes might well finally overflow.

U.S. manufacturers Monsanto and Eli Lilly have waited for years for the massive employment of their cow medication in Europe. Now they can breathe a sigh of relief: According to Bangemann's blueprint, "the Community must avoid situations which produce uncertainty." The guidelines for licensing are limited to "clear, objective product criteria," not nebulous social hurdles like the Fourth Criterion.

But the strategy paper contains even more trump cards for the march of the genes. Special regulations for compounds derived by genetic engineering are generally rejected by EEC market strategists. The anticipated biotechnology boom, they claim, can be controlled by existing product regulations.

Under current law, all medications are to be measured by the same yardstick. The only decisive factors for licensing are the three criteria of safety, quality and effectiveness. The testers are supposed to ignore whether the end product was brewed up in bio-fermenters or in the chemical laboratory.

The fatal results which can follow from the regulations, which are viewed much too generally, are shown by the soporific L-tryptophan, which was produced from genetically engineered bacteria. Twenty-seven people died from it in the U.S. in the summer of 1989. A tiny mistake which a new strain of bacteria had smuggled into the compound transformed the substance into a toxic killer.

Bangemann also wants to loosen the alleged stranglehold on genetic research. At the moment strict regulations are in force for the protection of workers in the genetic laboratory. Open-air experiments must be approved, waste carefully disposed of, new projects subjected to a "risk assessment."

For months the industry has been staging an assault on the supposed obstacles to their inventive drive. Bangemann is now granting the entrepreneurs a hearing: according to the policy paper, "research in the forefront of market licensing is left in the hands of the companies themselves"; the "incentive for innovative competition" must not be limited.

Critics like the Green EC parliamentarian Hiltrud Breyer see the new EC line as "a softening of existing laws"; biotechnology is being given carte blanche with the "knockout argument of competitiveness." Wolfgang Loehr of the Network for Genetic Ethics in Berlin also sees no cause for celebration in this course of action: "Consumer protection is being completely neglected."

But Bangemann is satisfied. If his catalog of demands goes into effect, hw says Europe can hold its own in international competition. Ethically awkward questions, for instance regarding experimenting with fetuses, are to be judged "case by case" by a committee on ethics. Here too there will be no clear gidelines for, as the wisdom from Brussels has it, "there are no general solutions to ethical problems."

Still, the commission does not intend to give the green light to: the strategy paper states that "everybody would probably reject patents on human beings."

Germany: Electrical Pulses Aid in Genetic Transfer, Cellular Fusion

91P60160 Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 29 Apr 91 p 10

[Text] Bio-med GmbH in Theres, Schloss Ditfurth, has developed two devices making possible gene transfer by means of electrical pulses. According to statements by business manager Dr. Hardo Freiherr von Grise, the devices can be used for cellular fusion and electroinjection. Contemporary genetic engineering deals with the

penetration of genetic materials into a cell. For some fields of application, however, entire cells are fused with one another.

This cellular fusion is necessary, for example, for the generation of hybridoma cells serving for the manufacture of monoclonal antibodies. The cultivation of plants also employs cellular fusion. As stated by Grise, electrical cellular fus;on was developed as an alternative to convent;onal fusion techniques. In these [latter] techniques, cells are fused together using chemicals or inert viruses.

Of course, conventional methods are mostly unsatisfactory with regard to the yield of fused cells. The firm's Biojet cellular fusion (CF) device now makes possible microprocessor-controlled electrical cellular fusion. The [device] consists of a high voltage pulse generator which produces the DC pulses required for cellular fusion, the switching electronics and a variable field generator.

In order to fuse cells, they are introduced into a fusion chamber in a medium amenable to osmosis. The variable field generator, operating at frequencies between 0.1 and 10 MHz, sets up a variable field in the chamber. The cells gravitate toward the electrodes, forming pairs there or short chains. Once this process is set into motion, fusion itself is introduced by means of a high voltage pulse which generates a rectangular pulse of 5 to 100 microseconds duration.

The maximum voltage is 400 volts (V). The pulses can be released at intervals of from 0.1 second to 999.9 seconds. The strong pulses penetrate the cell membrane and usher in the fusion of adjacent cells. The process is controlled using a microprocessor. It also permits the storage of various fusion programs.

The firm's other [new] device offers the possibility of electroinjection of substances into individual cells. According to Cise, this injection is simple and gentle to the cells [involved]. [The injection] can be employed for transferring molecules of hereditary material (DNS), dyes, proteins and pharmaceutical substances, as well as for liberating substances from a cell. Here then, an electrical pulse of up to 15,000 volts (V) renders a cell membrane permeable. The cells themselves subsequently repair the membrane.

COMPUTERS

EEC Urged To Launch Supercomputer R&D

91WS0255A Paris AFP SCIENCES in French 28 Feb 91 pp 26-27

[Unattributed article: "EEC Must Launch High-Performance Computing Program"]

[Text] Brussels—In Geneva last week, eminent European leaders in the scientific and industrial sectors, including physicist and Nobel Prize winner Carlo Rubbia, the present director of the CERN [European Particle Physics Laboratory], urged the EEC to venture forth into high-performance computing, from which it is "totally absent" and which demands revolutionary technologies. At the very least, 1 billion European curency units [Ecu] must be invested in research in this field by 1995.

The report, addressed to the attention of the EEC, points out that understanding and control of the physical, economic, and social systems are at the threshold of major advances, but that progress will depend on the availability of adequate computing power at speeds 1,000 times greater than that of the fastest computers available today.

Such machines, which can reasonably be expected to be developed before the year 2000, "are going to revolutionize all sectors of science," the report predicts. As a matter of fact, computing requirements in the scientific, economic, and social fields will necessitate computers capable of performing numerical simulations at speeds of 1 trillion operations per second, at minimum. Indeed, computers of this type will be the only ones capable of replacing the costly, hazardous, exceedingly complex, and, in fact, otherwise-impossible process, practically speaking, of experimenting with real objects, to develop the required models. The aerospace, chemical, pharmaceuticals, and automotive sectors are going to be affected, but also those of industrial and social planning.

The working group headed by Professor Rubbia proposes a major initiative based on five interdependent lines of action:

— Promotion of high-performance computing, including the development of an advanced pan-European communications network aimed at stimulating the innovative use of the most powerful machines currently available;

— Development of a European high-performance computer industry. This industry must be competitive, internationally, as concerns the conceptualization, design, and production of advanced machines as well as of the equipment needed for their operational environment;

— Development of software, including entirely new concepts, designed to exploit the possibilities offered by the evolution of high-performance computer architectures and their real-time interactive use;

— Mobilization of industry, universities, and major research laboratories to effect the basic and applied research necessary for improving the European competitive potential in this sector. This effort must include, in particular, advanced pilot projects, with funding by the European Commission, and requiring close cooperation between the most advanced users and the fledgling European industry;

— Fostering of education and training in all the sectors connected with high-performance computation. The critical shortage of engineers and scientists trained to

design, develop, produce, and make efficient use of these high-performance systems needs to be overcome.

The report suggests a progressive instituting of funding from different sources aimed at attaining the necessary 1 billion ecus by 1995, terming the necessary decisions to this effect "crucial" and "urgent." It cites the current European R&D programs such as ESPRIT [European Strategic Program of Research on Information Technologies] and RACE [Research on Advanced Communications in Europe] as important to the initial phases of this undertaking, and calls for participation and commitment by the European users of high-performance computation techniques as vital to its success, and a firm commitment at policy levels as equally vital to its continuity.

French Progress in Neural Computing Reviewed

91WS0298A Paris INDUSTRIES ET TECHNIQUES in French 22 Mar 91 p 13

[Article by Alain Perez: "IA (Artificial Intelligence): Efficiency Won't Wait for Numbers of Neurons"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] To begin, simple applications will have to do: status report from OFTA (French Observatory for Monitoring Advanced Technologies).

New departure for systems include neural networks. After too many empty promises, [there is] a turn now to developing simple but solid applications. "With a few hundred neurons, we can set up some fine industrial applications. A few dozen neurons is enough for a decision to proceed," indicates Gerard Dreyfus, a professor at the ESPCI [Higher School of Physics and Industrial Chemistry] in Paris, who just finished a research study on behalf of OFTA. "What matters is not the number of neurons, but the management of the network and the learning algorithm. Existing systems possess the cognitive capacity of a mollusk. But that is already enough. These techniques are incomparable for modeling nonlinear processes," says Gerard Dreyfus. This is the case for form recognition, the automatic classification of data, the prediction of complex phenomena or fault-tolerant systems.

Some current applications justify this deliberate pragmatism. The first, an industrial one really, takes place in the automatic recognition of postal [ZIP] codes.

Neural Networks Much Faster

"The error rate is no better than that of classic systems, but the neural networks are incomparably faster," says Gerard Dreyfus. The Waterworks of Lyon, in collaboration with the Technical University of Compeigne, has set up a prototype devoted to the prediction of water corrosion in materials. EDF (French Electrical Utility) is looking at a similar application for the heat exchanger tubes of nuclear power stations. Thomson and Philips envision some very important opportunities in the compression of images, equal progress on the composite materials front. Philips has added a circuit on silicon to the first circuit developed by Intel. A French composite financed by DRET (Directorate of Technical Research and Studies) will appear in a few months from Grenoble.

Meanwhile, this technique will remain reserved for a handful of industrialists with endurance and means. "If you are serious, you need to begin with a three-year development plan. The people starting out have to be very well trained. One will need to be operational immediately to bring about something new. If not, you risk reinventing something already in existence and becoming discouraged rapidly." Gerard Dreyfus also knows about industrial sluggishness and remains cautious. "It takes 10 years to replace a technique in industry. These are simple examples which will cause neural networks to make progress." A healthy humility, considering that the human brain contains 100 billion neurons and that 100,000 of them die each day.

FACTORY AUTOMATION, ROBOTICS

ESPRIT: Renault, Aerospatiale Test CNMA LAN Project

91WS0336A Paris TECHNIQUES & EQUIPEMENTS DE PRODUCTION in French Apr 91 p 11

[Article signed D.C.: "CNMA [Communication Network for Manufacturing Applications]: A Super-MAP Network"; first paragraph is TECHNIQUES & EQUIPEMENTS DE PRODUCTION introduction]

[Text] The CNMA project of the ESPRIT [European Strategic Programs for Research and Development in Information Technology] program will provide an industrial local-area network compatible with MAP (Manufacturing Automation Protocol) and with TOP [Technical Office Protocol], while managed according to ISO standards. It can be monitored in real time, and uses an expert system for failure detection and diagnostic.

The CNMA project of the ESPRIT program was started in 1986, a few years after the Americans had proposed the MAP protocol. Although they woke up late, the Europeans are now regaining an advantage with respect to openness and functionality. Set for six years in 1988, the latest MAP version, version 3.0, is no longer changing, while the CNMA protocol has reached its fourth stage of development, an additional stage being expected by 1993. Its latest developments enable the CNMA network project to remain compatible with the MAP and TOP protocols, while complying with recent ISO standards implemented in this field. This enhanced communicability will provide more flexibility to the various partners, users and suppliers who took part in the project (Renault, Aerospatiale, Bull, Alcatel, TITN

[Information Processing-New Techniques], Siemens, Aeritalia, Olivetti, the Stuttgart and Karlsruhe universities, etc.).

Two pilot sites are operational in France, one of which is at Renault. The French automobile manufacturer, who provided a budget of 7 million French francs [Fr] for the project, has a data-processing platform with two local-area networks using a variety of hardware (programmable controllers, numeric controls, cell controllers, workshop controllers, etc.). "Each of our plants now possesses close to 1,500 mixed items of data-processing hardware and manufacturing equipment from 15 suppliers or so," Florence Langlois, head of the pilot site, explained. "We must therefore use several network levels to ensure that these items communicate with one another."

Total quality being Renault's priority objective, network management will have to be as reliable as possible. One of the angles on which Renault is now working is the permanent monitoring of the network itself, in order to detect and diagnose any failures, using an expert system which is currently being enriched.

Two Pilot Sites in France

This platform is linked to another pilot site located at the Tactical Missiles Division of Aerospatiale, in Chatillon, near Paris. Named Appolo (Prototype Production Workshop with Optimized Scheduling and Launching), it consists of a fully-integrated flexible workshop designed to manufacture missiles. It includes seven numeric-control machines, one measuring machine, one automated store, and one self-controlled laser-guided handling trolley. The workshop is piloted by a supervisor who, in addition to monitoring production, is also in charge of optimizing scheduling and launching. "Currently in the industrialization stage, this workshop enables us to test in an industrial environment the communication software developed under the CNMA project," Francois Kiefer, the project leader, told us.

New French Software Directs Robot Trajectory

91WS0306B Paris L'USINE NOUVELLE/ TECHNOLOGIES in French 21 Mar 91 p 18

[Article by Bernadette Lacaze: "'Smart' Off-Line Programming: The Nantes ENSM's [Advanced National Mechanics School] Software Program Directly Optimizes the Robot's Path"]

[Text] Operators will soon be freed from the need to feel their way on a graphics screen when plotting, off-line, the trajectory that a robot must follow to accomplish a specific task. The automation laboratory of the Nantes Advanced National Mechanics School (ENSM) is putting the finishing touches on a new software program that will provide directly usable information on the feasibility of the task.

The use of this new approach to the spatial design of robotized work sites optimizes the positioning and trajectory of the robot so that the cycle time is as short as possible. The procedure is completely formalized. Each factor involved in decision-making is modeled. It is the program's job to take these data into account to calculate the area that can be traversed without risk of collision. To do this, it must define the proper intersection between three elements: the robot and its casing, the areas to be reached to perform the task, and all obstacles.

The path determined by the program can consist either of linking several points in space, as in the case of arc welding or object manipulation, or tracing out a shape, as in seam welding, painting, or deposit of an adhesive.

Research was conducted in collaboration with the PSA (Peugeot Corporation) group and Renault Automation.

It should result by next October in a product, marketed by the Sitia Company, that will run on a work station and be interfaced with standard tools.

Bull's Started Calibration System Described

91WS0298C Paris INDUSTRIES ET TECHNIQUES in French 22 Mar 91 p 53

[Article by Sandrine Dewez in Production Section: "Data Processing: Automatic Calibration of Cathode Ray Tubes"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] Bull has installed calibration racks using image processing. The work goes four times faster. Quality has improved.

Bull, in Villeneuve d'Ascq, has solved the problem which all computer manufacturers encounter: the very costly manual adjustment of the geometry of the image on the CRT [cathode ray tube] screen. An indispensable step at the end of the assembly line. The technician assigned to this work must do long and tedious manipulations. He must lean over the back of the apparatus, where the adjustment controls are, move one of them, step back to check the result, and start again on the other.

The Results Are Completely Repeatable

These operations, anachronisms on an automated assembly line, also give the quality of the product a subjective character, tied to the expertise of the operator.

To put an end to the "handicraft" character of this calibration, Bull called on Delta Technologies, an SSII [Data Processing Services and Engineering Company] specialized in industrial computerization, for Bull's Questar line of terminals. They perfected Startec. Thanks to this equipment, the technician operates each of the adjustment controls once and once only: He sees the results of his action immediately on a monitor. For each adjustment, a display shows him the position compared to the optimum and the accepted tolerance. Direct control of the CRT has become unnecessary, the ergonomics of the work station have been improved and the time required for each terminal has passed from 20 minutes to five. Besides, the repeatability of the results is

total and the tolerance twice as good as manually. So Mr. Cordiez, in charge of robotics at Bull, has every reason to be satisfied. He regrets only having "to be the first occupant of the house." Setting up the five racks at Bull took all of six months. That's the price of pilot systems...

The Startec system consists of a monitoring and detection camera which sends an image of the display to a digital processor. The video signal is quantized, then a depiction of the contour. The apparatus then calculates the center of gravity of each object. The result is sent to a microprocessor. From this data, the algorithm created by Delta Technologies determines the corrections needed. The software then generates the help display destined for the operator.

Startec will soon be put on the market for a cost of about 600,000 francs. This price includes the camera, the image processing program, the Startec license, training, and setup. In the future, "the installation will barely take a week," we were told by the manufacturer, who is about to work on the automation of the final phase of test and calibration.

Germany: Improved Sensors Advance Robotic Assembly Operations

91WS0328A Coburg MASCHINE & WERKZEUG in German Mar 91 pp 82-90

[Article by Uwe Schweigert, graduate engineer, scientific associate, Fraunhofer Institute of Production Engineering and Automation (IPA), Stuttgart (Director: Professor Hans-Jurgen Warnecke, doctor of engineering sciences): "Robots: Sensor-Guided Robots in Assembly Operations; Application Capabilities Extended Considerably"; first paragraph is introduction]

[Text] Sensors are extending considerably the application capabilities of industrial robots. Areas of application in assembly exist in making parts available, control of gripping and joining processes, in tolerance compensation and for testing and inspection tasks. Whereas only a few years ago applications of sensors in assembly by means of industrial robots were reserved for research labs and development facilities, today industrial practice would be unthinkable without them.

Technically and economically efficient robotic assembly with sensors is being made possible because of higher-speed, low-cost data processing, as well as because of the growing number of sensor manufacturers and sensor types, higher measurement accuracy and a cost-performance ratio that is becoming ever more favorable. In addition to growing demands on flexibility, especially process assurance and control for the improvement of manufacturing quality are placing new demands on industrial robotic assembly systems that require the multiple use of sensors.

Types of Sensors and Sensor Tasks

Sensors are the parts of a measuring device that are exposed directly to the phenomenon to be measured or detected. This narrow definition is being broadened considerably in its application in automation systems. Here sensors serve the purpose of detecting random effects in the entire surrounding field of an industrial robot, of measuring physical quantities, as well as of pattern or position recognition. Tactile (contact) sensors furnish information on forces that act on the robot, e.g., pressure or feed forces in machining, cleaning of castings and grinding, or joining forces in assembly operations. Noncontact sensors grasp three-dimensional situations by means of picture recording and picture evaluation, e.g., for the identification of workpieces, determination of position and orientation, tracking of fusion welding sheeting or testing tasks.

The sensors that are finding application in industrial robots today are composed of the following components:

- Transducer (contact, noncontact)
- Converter (analog-digital, digital-analog, pulse-counting)
- Amplifier (linear, nonlinear), and
- Analyzer (measurement-result/log curve, strategy)

Without an external sensor system adapted to the particular task, robots, to be sure, are in a position to repeat as often as desired the preset sequence of motions, but they cannot react to unforeseeable events in their immediate environment. Sensors are supposed to establish communication between the industrial robot and its periphery so that an intended sequence will be achieved also when the immediate environment changes within certain preset limits.

There is direct contact at an operative contact (tactile) sensor, and accessibility to the object of measurement is necessary in this case. Force-and-torque sensors, which are integrated into the gripper or tool of an industrial robot, form the most important group within tactile sensors. Strain gages, inductive transducers, capacitive transducers, potentiometers, pneumatic tranducers and mechanical tactile devices are used as signal pickups in these sensors.

Operative noncontact sensors can be used as one-way switches (photoelectric relays, reflected-light scanners) or, by way of a linear, e.g., areal, arrangement, for the purpose of pattern registration. The following physical principles are employed for the purpose of signal pickup: optical, capacitive, electromagnetic, inductive or fluidic.

Sensor systems for assembly use must perform very different tasks that differ considerably depending to some extent on the area of application. When parts are being made available, joining parts have to be identified and their position or rotation position must be determined for subsequent orientation in the process of being separated and fed by the industrial robot. The grip process can be assured and the grip force as well as the gripper opening and closing paths be controlled, by means of sensors integrated into the gripper systems.

Before and during the joining process the assembly robot or rather its gripper systems often must perform tolerance compensation, which is controlled and supported, or often even just made possible, by means of appropriate sensors. Force-and-torque sensors serve for position identification in

a contact process, and in a noncontact process, mainly optical and optoelectronic sensors, which prepare the subsequent precision positioning process.

Joining forces and joining paths have to be sensory controlled during assembly in order to assure a proper joining process and to avoid damage to the workpiece, tool and the robot itself. Finally, a multitude of testing and adjustment tasks has to be performed, in order to monitor the course of processes, to enable adjustments and ensure the success of the individual assembly processes.

The sensors used in conjunction with robots for assembly and handling tasks can be divided into contact and noncontact sensors and measuring systems. Contact (tactile) sensors comprise feelers, feeler matrixes, force torque sensors and force/path measuring systems.

Noncontact sensors comprise both optical sensors like photoelectric relays, fiber optic sensors, laser range sensors, laser scanners, CCD linear array sensors, image processing systems, photoelectric proximity sensors and incremental path measuring systems, and nonoptical sensors like ultrasonic sensors, pneumatic sensors, proximity sensors (capacitive and inductive), and eddy current sensors.

Additional sensor functions for the measurement of temperature, flow, pressure, potential, gas composition, etc., that can be considered here only in passing, have to be implemented for inspection, or, as the case may be, testing tasks, as well as process control and adjustment

Sensor Applications in Industrial Robotic Assembly

Area of Application	Sensor Tasks	Type of Sensor (Measurement Principle)	Assembly-/Robot Tool	Application Example
Making Parts Available	Part recognition	Image processing CCD sensor Photoelectric relay Laser scanner	Robot- guided camera Photoelectric relay system Robot-guided laser	Making electronic components available O-ring separation
	Position recognition	Image processing CCD sensor Proximity sensor Feeler matrix	Television sensor Programmable vibratory hopper conveyer Tactile gripper	"Grab in the box" Programmable separation device Sensor-supported arranging
Gripping Process	Presence monitoring	Proximity sensor Reflex photoelectric relay Vacuum sensor Matrix feeler	Standard gripper with sensor integration Vacuum gripper Insertion gripper	Assurance of gripping process Electronic component insertion Die bonding
	Gripping force control	Strain gages Load cells Frictional force sensor Slip sensor	Tactile gripper jaws Tactile gripper Gripping force control with frictional force measuring	Handling of —delicate joining parts —miniature parts —flexible parts
	Gripper path control	Incremental path measuring system Proximity sensor Photoelectric relay	Programmable standard gripper Insertion gripper Miniature parts gripper	Assembly of various joining parts Insertion of electronic components Precision engineering
Tolerance Compensation	Contact position recognition	Strain gages Force-and-torque sensor Proximity sensors Photoelectric proximity sensor	Tactile robot hand Active RCC Compliance system with magnetic force control	Tactile bolt and pin mounting Avoidance of tilting
	Noncontact position recognition	Image processing Laser range sensor Photoelectric proximity sensor	Robot-guided —camera —laser range sensor —photodiodes	Insertion of electronic components Wiring harness assembly Hose assembly Miniature parts assembly
Joining Process	Joining force control	Strain gages Load cell Force-and-torque sensor technology	Tactile gripper-and-sensor systems Touch-down sensor	Snap-on assembly Press-fit assembly Die bonding Hose assembly
	Joining control	Incremental path measuring systems Proximity sensors Photoelectric proximity sensors	Chompliant joining axis Spring deflection module	Assurance of joining process Wiring harness assembly Vibratory assembly
Testing Inspection	Process control	Thermocouple elements Proximity sensors Flow measurement Force measurement	Programmable robot tools —soldering tool —dosing head	Soldering robot Cementing robot Casting robot Die bonding
	Adjustment	Image processing Path measuring systems Force measurement Potential measurement	Flexible gripper systems Bending tools Adapters	Adjustment of —optical systems —relays Potentiometer adjustment

Sensors for Making Parts Available

In the making of parts available, sensors serve for detecting the position of workpieces made available in an imprecise or unarranged fashion, as well as for object identification when various mixed workpieces being made available are being separated and fed. The so-called "grab in the box," whereupon workpieces made available in unarranged fashion as randomly oriented parts would be selectively grasped and arranged, is an important development goal. Such an application is technically possible today by means of gray-scale-value-analyzing image processing systems, but it is not yet economically feasible for cycle time reasons and on account of the high investment cost.

The Fraunhofer Institute of Production Engineering and Automation (IPA) has developed a process that makes possible a select special case of the "grab in the box" without high sensor costs. In this case O-rings are separated from randomly oriented parts by means of an industrial robot or automatically, and surplus grasped O-rings are taken off again when they pass through a brush arrangement. It is possible to determine by means of a photoelectric relay that passes through subsequently whether an O-ring was removed from the randomly oriented parts at all and whether all surplus O-rings have been taken off.

When workpieces are being made available regularly within a defined area, it is possible to determine by means of an overhead camera and an image processing system connected to it whether the workpiece in question is in the desired assembly position. In addition, whether the workpiece is in perfect condition can be determined by means of pattern processing and, if necessary, it is possible to enable the selection of a specific workpiece from various objects. The following principal industrial application fields exist:

- Preparation of workpieces from arranged parts on conveyer belts
- Preparation of workpieces on x-y coordinate pallet tables
- Preparation of chips on sawn wafers and
- Preparation of wired electronic components on sponge rubber mats.

Vibratory hopper conveyers in which workpieces are separated, fed and made available in the correct position by means of mechanical arranging systems often serve for making parts available in automated assembly systems. The programmed workpiece contour can be recognized by the use of an optical line sensor just ahead of the discharge zone of the vibratory hopper conveyer, and this makes it possible for various workpieces to be made available in the correct position.

The systems mentioned bring flexibility to feed techniques in assembly systems without absolutely requiring an industrial robot as a handling device. With vibratory hopper conveyers with built-in sensors, parts are always, as hitherto, made available at a defined place and in a defined position, so that workpieces can be taken on also from conventional nonprogrammable handling devices.

Sensors for the Gripping Process

Sensors in the gripper itself that serve the purpose of ensuring the gripping process, i.e., of checking whether the workpiece has in fact been gripped and lies within the gripper jaws, are nearly already a technical standard. Proximity sensors, reflex photoelectric relays and matrix feelers that are fastened to the inner surface of the gripper jaws are used for this. Suction grippers are generally being furnished with vacuum sensors and are in wide use as grippers for chips and electronic components for surface mounting (SMT).

The handling of delicate and fragile joining parts by an industrial robot requires sensitive gripper systems that make possible high- resolution programming, measurement and control of the gripping force. Especially the handling of tolerance-affected, delicate miniature parts requires, in addition to programmability of the gripper opening and closing paths, sensory control of the gripping force. Then the gripper closing motion can be programmed for the smallest possible joining parts. If the maximum permissible gripping force is exceeded in the closing action of the gripper jaws for joining parts having—by reason of the workpiece tolerance—greater external-dimension measurements, the closing action of the gripper will be automatically stopped, in order to avoid destruction of the joining part in question. Gripping force control has to be planned in automated industrial robotic assembly also for inherently flexible joining parts like hoses for example, in order to avoid too strong squeezing of the joining part and the hampering associated with this, of a proper assembly process.

The gripping force that occurs can be measured directly by means of matrix feelers or strain gages in the gripper jaws. In the same way, indirect limitation of the gripping force by measurement of the frictional force between the joining part and gripper jaws by means of slip sensors is possible, or limitation of the gripper's closing force via the motor current, for example. In order to be able to handle automatically delicate workpieces having varying dimensions, gripper systems having programmable opening and closing paths are used, that by now are available on the market as standard grippers. The grip path is registered in this connection by means of incremental path measuring systems, proximity sensors and photoelectric relays. Such grip systems are suited particularly for the insertion of special electronic components into printed circuit boards or the assembly of precision joining parts.

Sensors for Tolerance Compensation

The often necessary compensation of the tolerance between the position of the joining part and that of the base part directly before or during the actual joining process constitutes the main problem in automated assembly by means of industrial robots. Such tolerance

compensation is always required, moreover, if the cumulative tolerance, made up of the sum of the position deviation owing to the workpiece tolerance and the tolerance of the assembly system, exceeds the minimum available joining play for workpiece mating and sufficient chamfers are not available on the workpieces. Tolerance compensation can be effected by precision positioning of the joining and base parts. For this the deviation in the positioning of both workpieces relative to one another has to be registered beforehand by means of contact or noncontact sensor systems. Tactile (contact) sensors require mechanical contact and, with that, good accessibility to the object. In direct force-and-torque measurement the forces and torques acting on the sensors are measured directly and further processed. Primarily strain gages (DMS's) are used as transducers in this case. The information concerning the forces and torques acting on the sensor is gotten by means of path measuring when the second measuring principle, indirect force-and-torque measurement, is used. By proper designing of the sensor, deflections of the spring- mounted parts of the sensor on account of the acting forces and torques are kept toward a fixed reference plateau. The amount of this deflection is then proportional to the acting forces and torques. Tactile joining processes are suitable for universal application in industrial robotic assembly, but their industrial application has thus far been thwarted by too long a cycle time and the high cost of sensor technology and measured variable processing.

Position recognition with noncontact sensors for tolerance compensation is finding increasing application in industrial practice on account of dropping prices and the improving performance of image processing systems. Tolerances of base parts and base part settings can be determined and compensated by means of robot-guided cameras. This technique is used above all in the automatic insertion of components into printed circuit boards, chip assembly and in precision assembly tasks.

But the compensation of often relatively large joining part tolerances is also rendered possible by the use of image processing systems. Stationary cameras past which the handling system with the joining part travels are already the state of the art for the purpose of measuring the terminations of complex components in pick-and-place machines for SMD components. Techniques with robot-guided cameras make it possible to measure joining parts in the course of the robot's process motion without cycle time loss. These techniques have been studied and their technical feasibility established at the Fraunhofer Institute of Production Engineering and Automation (IPA) for the connection of termination parts in wiring harness assembly and the assembly of electronic components by measuring their leads.

Sensors for the Joining Process

The joining force that occurs can be registered and controlled in the actual joining process by means of strain gages, load cells or force- and-torque sensor technology, in order to avoid damage to the workpiece and tool on account of too high joining forces and to enable a joining process that is defined with respect to forces. Thus, it is possible to verify in the assembly of snap-on connectors, for example, whether the joining force that occurs lies within the prescribed range. Too low joining forces make an adequate snap-on connection impossible. The joining part could work loose again from the base part after assembly. If the joining force exceeds the maximum permissible value when the joining part is snapped into the base part, the assembly process has to be stopped in order to avoid damage to the joining partner and the gripper tool.

The joining forces that occur are controlled and limited by means of elaborate gripper-sensor systems or a force sensor that is integrated into the grip system and that measures in the joining direction. Fitting bolts and pins tightly into close-tolerance holes, joining processes with very little joining play, and also hose assembly are further areas of application of these sensors. In die bonding the chip can be put with a defined application force onto the molten solder, or the conducting bonding paste, with the aid of a touch-down sensor, and optimal bonding of the chip to the bonding material can be guaranteed in the process.

In order to assure the joining process it quite often suffices to control the joining path. Incremental path measuring systems, proximity sensors or photoelectric proximity sensors are integrated into a spring deflection module in this case, or the joining axis is compliantly displaced and the compliance is measured. Placement of the joining part outside the joining position on the base part or tilting during assembly can thereby be recognized immediately and the robot's joining motion can be stopped. Control of the joining path also makes it possible for an active tolerance compensation system with a vibrating support to function. Here the spring deflection path of two plane-parallel plates connected to one another by means of curved leaf springs is limited by means of a proximity switch. If the joining process is disturbed by off-center placement or tilting of the joining part, the robot stops the joining movement and switches in the tolerance compensation system with the vibrating support. Successful tolerance compensation is recognized from the proximity sensor, and the joining motion is continued by the robot.

Sensor Control Parameters

Industrial robots are ever more frequently taking over assembly tasks that include special process runs. Parameters involved in the process have to be sensory controlled in order to assure these process runs. This is resulting in assembly tools that are becoming ever more complex and in extensive processing of sensor data. Special robot tools have already been developed for

soldering, cementing, casting and bonding. Temperatures, volume flows, pressures, forces, vibrations, etc., are registered by sensors in this case and are used for process control.

A sensor-guided soldering tool for individual welding or multiple welding with a soldering iron requires a multitude of sensors. The following are sensory controlled in this example:

- The soldering iron's temperature
- The application force, or the spring deflection path, of the soldering bit along the x- and y- axes
- The existence of soldering wire and
- Contact between the soldering wire and the soldering bit

The control of these parameters is of decisive importance for a successful soldering process and consistent soldering quality.

Finally, testing procedures performed by a robot should in the future enable automatic success checking when assembly has ended. Costly visual inspection should be taken over by image processing systems then. Developments in this area are still in their infancy. In particular, changing lighting conditions and reflections at the testee still cause considerable problems. This applies also to automatic adjustment if optical measurements have to be taken. On the other hand, the control of electrical parameters and automatic adjustment—of potentiometers, for example—by means of the robot are already the state of the art.

Development Trends

The development trends in the field of sensors can hardly be described completely. Development work is under way on sensors worldwide and new robot applications are being prepared for. Intensive work is under way on both optical and tactile systems and there is a multitude of extreme examples where sensors are being used in conjunction with robots in laboratories. Within this class fall sensitive grip systems that are modeled on the human hand, mobile robots and robots with fast optical sensors, like, for example, a "table tennis player" developed in Japan. The industrial assimilation of these exotic developments undoubtedly still lies several years ahead.

Nevertheless one can note the growing use on a wide front of sensors in conjunction with robots. Most uses in industrial practice are for process control, as well as for gripping and joining operation control. Areas of application in adjustment and for tolerance compensation are advancing. Tactile systems, originally and still the favorite, remain restricted for cycle time reasons to only a few cases of application and bench-scale tests, whereas the strongly growing trend toward the use of image processing systems in robot stations can no longer be stopped.

Germany: AI, Expert Systems Key to Future CIM Introductions

91WS0264A Duesseldorf VDI NACHRICHTEN in German 15 Mar 91 p 11

[Article by Bernd Eusemann: "The Future Role of Artificial Intelligence in Manufacturing—Each Automation Task Is Unique—Decentralized CIM [Computer-Integrated Manufacturing] Approach Keeps Manufacturing Flexible"]

[Text] At the CeBIT '91, producers presented a number of automatic manufacturing solutions. However, increasing flexibility requirements and the high cost are preventing a speedy transfer of these solutions to the factory floor. Now there is hope that the old CIM dreams can be realized by using improved methodology, i.e., more advanced expert systems.

The processing of very large and complex sets of data is the weak point of computers, since conventional computers operate sequentially: The CPU processes one task after the other and sends the results back to memory. The drawback of this method for factory automation is quite evident even if only simple assembly tasks are involved.

Full automation of manufacturing lines requires precise recognition of the individual parts. If true flexibility is the goal, a broad range of parts need to be recognized, regardless of their location at any one time. The human visual system with its parallel signal processing masters this task without any problems; industrial image processing system, however, quickly reach the limit of their capabilities.

Nevertheless, in the past few years great efforts were made and concepts were developed in the area of CIM to succeed in automating the factory despite the obvious difficulties. Currently, most experts will agree that about two dozen companies in the Federal Republic have comprehensive integration solutions in place. At conferences, people are even starting to talk about a post-CIM era.

"At least in individual sections, the automotive industry has been trying to implement full automation," says professor Hans-Joerg Bullinger at the Fraunhofer Institute for Industrial Economics and Organization in Stuttgart. "But at what price?" He claims that the productivity of the automated installations worth $20 billion is still lower than that of the old facilities. It is ironical that expectations with regard to cost savings had to be substantially lowered precisely because of increased flexibility requirements. "All of a sudden fully automated solutions could no longer be justified."

This does not mean that the CIM concept has been abandoned. Proponents of such solutions hope for a future new era in which it will be possible to realize the old dreams and make them affordable by using improved technology. Their expectations focus on expert

system and other achievements of artificial intelligence which have yet to be developed. As Bullinger sums it up: "The goal of full automation has simply been postponed; it has not been abandoned."

To be sure, in a statement to the press the organizers of the CeBIT '91 declared that it was "not possible to meet the high expectations of years past;" still, they held out hope that the "goal of a fully automated information and materials flow in manufacturing and in the technical and business areas is being realized step by step." Indeed, approximately 240 computer manufacturers, software partners and system houses are presenting their solutions in the key areas of manufacturing management and C-technologies. Their solutions are "not just dreams for the future, they can be implemented today."

Increasingly, medium-sized manufacturing firms are being courted and offered industry-specific and customized solutions. There are quite a few applications systems available, so that a customer should be able to find the CAD system suitable for his specific requirements. Such solutions have been quite successful in medium-sized firms. However, these automation islands do not yet provide a comprehensive flow of information; having a sizeable number of computers does not mean that computer integrated manufacturing has arrived.

The beautiful and bright CIM world as it is painted by the suppliers of related hardware and software is somewhat clouded by the warnings of production automation experts. They claim that CIM cannot be purchased off the shelf, and they do not even believe that one specific solution can apply to a whole industry. Each automation problem is unique, and each problem requires a specific solution to ensure a smooth operation. This is quite obvious when we consider that the integration efforts are directed towards company structures which have developed over time. This means that we need to address the problem of organization before we can apply methodology.

Having said all this, how does the CIM reality look today? Can medium-sized firms afford it? There are, of course, a few showpiece companies such as Arburg in the Black Forest, a manufacturer of injecting molding equipment for plastics. Despite a workforce of approximately 1,300, the firm places itself among medium-sized companies. The central data maintenance unit is connected to extensive communications networks, reaching from design to production, from order planning to delivery including parts management. However, Arburg had a very powerful partner to help in the development. Today, IBM is proudly showing off "its" model firm.

Thus, this is a special case which cannot necessarily be duplicated. It is, however, possible to implement the integration process without the assistance of a computer specialist. Mauser, a company located on the Neckar river, for instance, used scientists from the Fraunhofer Institute as consultants and handled the complete project management including interfacing in-house. No major industrial partner was involved. Overall, Mauser implemented a much more decentralized solution.

This points out an important difference in attitude in the present CIM discussions. Computer suppliers may tend towards centralized solutions. Fraunhofer researcher Bullinger prefers a more decentralized CIM approach and a reintegration of traditionally separate tasks because this "allows for greater variability of the manufacturing system."

Germany: TEIRO Robotic Programming System Described

91WS0253A Berlin FERTIGUNGSTECHNIK UND BETRIEB in German Feb 91 pp 77-79

[Article by Dipl.-Eng. T. Roediger, Friedrich List University of Transport at Dresden: "Large Assembly Welding With Robots—Collision Detection and Avoidance"; first paragraph is FERTIGUNGSTECHNIK UND BETRIEB introduction]

[Text] A program system for rational planning of the use of industrial robots is presented. It is based on a computerized method for early detection and avoidance of collisions.

0. Introduction

Large assemblies, particularly underframes and underframe assemblies for rail vehicles, present a significant potential for rationalization. There are 70,000 to 240,000 mm of seams to be welded—which breaks down into some 800 to 1,200 individual welds. Consequently, during preparation for the use of industrial robots (IR), a complex of individual data must be mastered. Also, the fact that the assemblies were not designed for automated production must be taken into consideration. In addition to technical control, decisive factors in an effective solution are the quality of the production of the components, the complicated tracking of seams and the IR's accessibility to the respective welding seam. This article deals with this last problem. Accessibility is limited by collisions of the IR with the assembly during its approach and during the welding of the seam. This hinders efficient automation. In view of the large amount of welding involved, it was essential to work out a rational solution to provide, during the stage of preparation prior to actual operation, a reliable determination as to which seams or portions of seams can be welded by IR's.

The specifics of the solution are influenced by two basic factors. There is no CAD [computer-aided design] model which could be used as a database for computer-assisted collision analysis. Second, the robot which will be selected is usually not yet known during this analytical phase.

Off-line programming systems with extremely varied collision test capabilities are offered for comparative analyses.[1-3,4] These systems use prior CAD stages for the description of objects. The collision test takes place during the final phase of use of the system or during preparation prior to operation, i.e., during or after the off-line programming. Here, the working tools and the design of the workcell

are known. Thus no fundamental conclusions could be drawn by analogy from their examples.

The TEIRO programming system is presented as a solution. The programming system consists of three parts: assembly modeling, robot modeling, and collision analysis. Collision analysis combines collision detection and collision avoidance, providing two avoidance strategies. For this, the objectives were to offer the user a readily understandable, manageable tool and to enable far-reaching use of data all the way to off-line programming and benefit calculation.

Assembly Modeling

Assembly modeling, i.e., the mathematical description of the object of investigation, is a prerequisite for the computerized solution. The underframe assemblies range in size from 1,000 mm x 1,000 mm to 3,000 mm x 27,000 mm and have a maximum height of 400 mm. They have a basic box and rib structure. When no CAD model is available from the design stage, a complete description is too expensive and unwieldy for the user. A principle of classification by type was selected because the assemblies have a single or double symmetric structure, the welded joints are mostly right angles, and the positions of the seams in the welded joints are highly repetitive. A complex joint which includes all structurally possible seam positions represents the centerpiece of the physical description of the joints. Environmental data are coordinated with the joints. These include data about the position and orientation of the joint in the assembly and about the obstacles located near the joint. An obstacle can be either an nearby joint or an element of the assembly. After the physical reproduction of the joint on the screen, the technical data on each welding seam are called up. Thus, an adequate description is assured for the collision analysis of the assembly. Data input is interactive with graphic support. The assembly drawings and documents about the sequence of welds are essential aids.

Robot Modeling

The modeling of the IR is a problem since the type robot to be used is usually not yet known at this stage. Depending on the characteristics of the assembly, collisions during welding are caused by the welding torch, the IR wrist, and also by the forearm. Consequently, collision analysis is performed using a so-called "pseudorobot." It consists of a forearm, wrist, a torch holder, and the torch. The contours and dimensions correspond to the most commonly used welding robots.

A 3-D wrist is kinematically simulated. Additional rotation and translation movements are possible to produce motions which are executed by the robot elements not illustrated here. For later off-line programming, it is possible to link the pseudorobot with the wrists of the real IR's through appropriate transformations. If a user has already decided on a specific type of robot, its model can be used exclusively in the investigation.

3. Collision Analysis

Conflicting objectives represent the fundamental problem in collision detection. On the one hand, highly accurate results are required and, on the other, short calculation times are essential. The selection of the method of mathematical calculation depends on the premises mentioned and on the structure of model. Examples for this are included in.[5]

Definition of the problem is characterized by the fact that the joint is described by a maximum of 60 polygons and the robot by approximately 40 polygons. The required result is a detailed statement about the two parties to the collision. This provides the basis for a suitable corrective movement. In order to obtain manageable output with a minimum time expenditure despite the great number of variants, a recursive method was developed for this. It basically consists of progressive limitation of the space investigated. This limitation occurs bilaterally, i.e., active regions above the welding seam position and the robot position are identified and then more closely tested in steps until a collision is detected. Mathematically, it was possible to limit the problem to a few intersectional operations, straight line with straight line, straight line with plane. These calculations can be executed very rapidly by computer.

This collision detection process is the centerpiece of the two collision avoidance strategies. A graphics "teach-in" and an automated process are offered.

The starting point for both processes is the selection and transformation of the robot into a typical initial position. Selection of the initial position takes place through evaluation of the actual location of the weld seam. Optimum torch approach angles are also taken into consideration. After the robot is positioned at the beginning of the seam, it is displayed on the screen. When the graphics "teach-in" is selected, a main menu becomes accessible. It is divided into three functional areas. The first part includes the movement functions of the robot. After selection of a movement, the angle of rotation or the path of movement must be entered. Through appropriate transformations, the robot is brought to its new position and the image displayed. The second group of functions consists of commands for graphics support. Visual assessment of the position is supported by the selective integration of the three dimensional projections. The third part includes the teach function and the control calculation. When this is invoked, the collision detection process is activated. If a collision occurs, a message appears on the screen. This message includes the colliding elements of the robot and the joint. In the graphics display, the latter is appropriately highlighted. A corrective movement can then be introduced. A safety routine constantly monitors the contact of the electrode point and the seam joint to see that it conforms to specifications. Thus, relatively slight defect corrections can also be detected immediately. When no collision is present, all wrist angles and positions of the robot wrist are stored in memory. At the same time, a determination is made concerning how much the assembly

must be manipulated (horizontal position, horizontal-vertical position). During the control calculation, a collision test occurs alone without storage of data. After conclusion of the collision analysis, the seam lengths which can be welded by robot are defined in terms of the joint and each individual seam. The entire data record can be stored on diskette and is added to the joint file. At the same time, a protocol can be called up. If joints which are identical in design and technology which differ only in their position in the assembly are present, collision analysis at only one joint suffices. The robot wrist data from the collision analysis can be transformed according to the position of the joint. This assures rational processing by taking advantage of symmetric features. Accurate data are thus available concerning the lengths of seams which can be welded automatically. At the same time, the data base can be used for off-line programming. Operational examples using the graphics "teach-in" are provided in Figure 1. The automatic process searches for a collision-free path. As before, the typical initial position is used as a starting point. Then there is a stepped progression of the robot along the seam. The width of the steps is calculated as a function of the length of the seam. This creates the relevant test intervals. In each position, including the beginning of the seam, the collision detection algorithm is invoked. When a collision exists, a corrective movement is selected and the required transformational specification is called up. The selection of the movements is based on various parameters, e.g., the colliding elements of the joint and the robot, the seam position, the joint type (e.g., joining of the components from both sides, overlapping joint, etc.), and the number and type of previous corrective movements already made. Calculation of the angle of rotation required or the path of movement occurs under evaluation of these data. After execution of the correction, a new collision test is activated. In a selection of a movement which leads to the swinging away of the point of the wire, i.e., the torch, from the weld joint, an appropriate corrective movement is implemented. The initial position angles of the torch are used as the boundary values for this. Usually, rotational movements are preferred. When these possibilities are exhausted, a translation of the robot in the direction of the beginning of the seam is invoked. For this, the movement path is calculated from the intersection of the elements of the robot and the joint. Absence of a collision results in termination of the test for this seam.

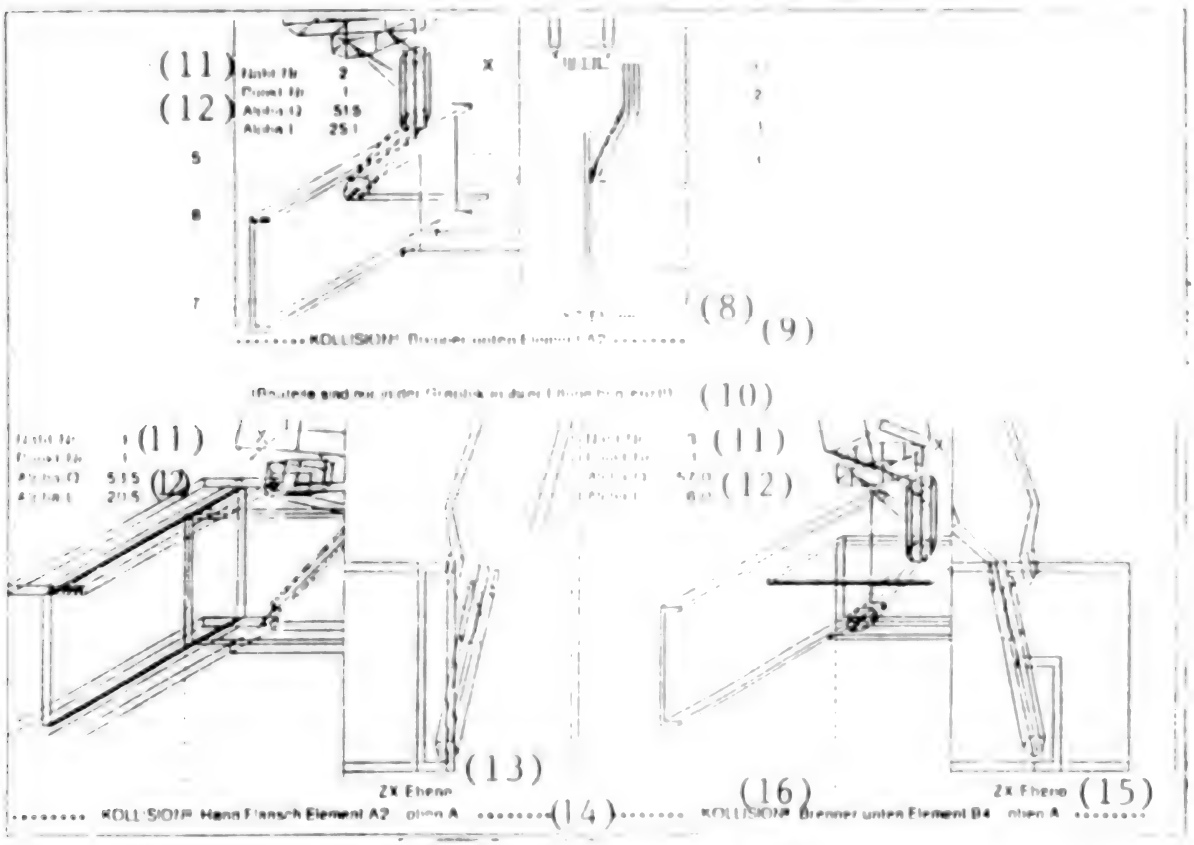

Figure 1. Examples of Collision Situations

Key: 1. Forearm—2. Hand flange—3. Torch holder—4. Torch—5. Colliding joint element—6. Joint element A (U-profile)—7. Joint element B (U-profile)—8. YZ planes—9. COLLISION" Torch bottom—element A2—10. (In the graphics, components are limited only in their length!)—11. Seam number—12. Point number—13. ZX planes—14. COLLISION!! Hand flange—element A2—top A—15. ZX planes—16. COLLISION" Torch bottom—element B4—top A

As in the graphics "teach-in" the wrist angles and positions are stored in memory after successful correction. Assembly modeling and collision analysis are the basic components of a comprehensive system for computer-assisted preparation prior to actual operation for industrial robots for welding large assemblies, particularly in construction of rail vehicles (Figure 2).

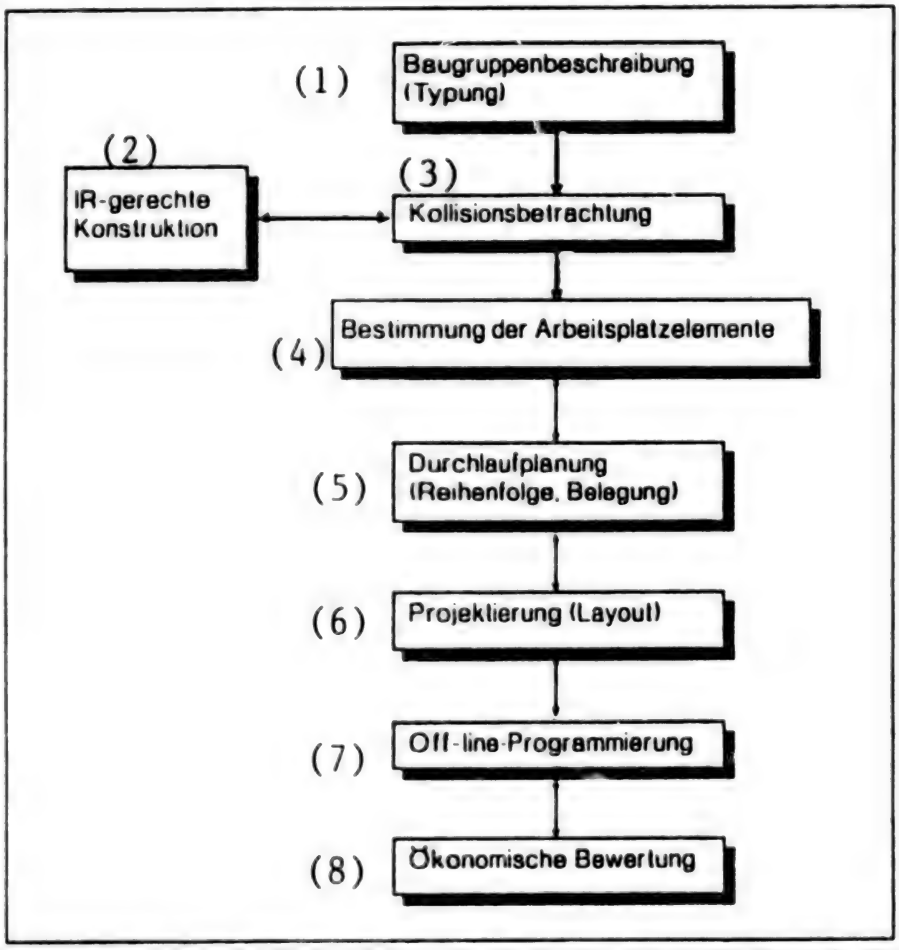

Figure 2. Comprehensive System for Rational Preparation for the Use of Industrial Robots for Welding of Large Assemblies

Key: 1. Assembly description (Classification by type)—2. IR-oriented design—3. Collision analysis—4. Specification of workcell elements—5. Process planning (Sequencing, work allocation)—6. Layout—7. Off-line programming—8. Financial assessment

The data derived from collision analysis can be used in many ways. In the design area, those joints where obstacles to the use of IR's exist are precisely defined and can be altered accordingly. Also, there are plans for general use during the design phase. The data are a basis for calculation of overall costs and production times. The maximum wrist rotation angles determined in collision analysis can be used, for example, in selection of the IR. Linkage to programs to generate technical production documents is also conceivable. It is possible that the programming system could be used to a certain extent in the design of welding devices. Elements of the devices can be evaluated as obstacles. Through modifying them during modeling, their design can be optimized to avoid collisions.

4. Summary

A programming system for rational planning for IR use is presented. Its basis is a computerized method for early detection and avoidance of collisions. The structural features of the assemblies were used extensively for the solution. Compared to testing on actual assemblies, this solution has the advantages of subjective freedom from errors and relatively fast processing as well as independence from actual production. The only requirements for preparation for the task are the sketches of the assemblies and the plans for the sequence of welds. Every effort was made during the design of the dialogue to guarantee user friendly operation.

Enhancements in the way of the potentials for selection of various different welding torches, integration of pendulum

motions for arc sensing, or the incorporation of programs for automatic selection of optimum welding parameters are conceivable in the future.

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Germany: Laboratory Robot Control System Developed

91WS0252B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 14 Feb 91 p 8

[Unattributed Article: "Robot System Automates Laboratory Work: Open Hardware Architecture With Standardized Modules"]

[Text] Isra Systemtechnik GmbH, Darmstadt, has developed a laboratory robot system in cooperation with the biochemistry and control system theory divisions of the Technical University Darmstadt Isra Systemtechnik GmbH, Darmstadt. The Laboratory Robot Control System (LRCS) is designed for use in industry, laboratories, and research and development. LRCS consists of an AT personal computer which provides the control logic for the complete system. A robot performs the manual tasks which consist of numerous routine laboratory activities such as the determination of enzyme activities in biotechnology and biomedical laboratories.

Isra placed great emphasis on making the system flexible. The company felt that such a system should be based on an open hardware architecture with standardized modules and user friendly software. LRCS uses MS-DOS as an operating system so that many programs can be used for data management. Moreover, the computer allows for the integration of many interfaces to facilitate future system enhancements.

Laboratory instruments such as titroprocessors or autoreaders can be connected using serial interfaces, pumps and incubators are controlled via binary interfaces. Image processing systems can also be connected. Sample preparation and sample measurement can be automated. There are also plans to automate systems solutions with sensors and application-specific instruments such as centrifuges, pumps and dispensers.

The various laboratory tasks are carried out by a modular robot with six axis-modules. It basically consists of an arm with a multi-function hand. The hand can be equipped with interchangeable finger modules to carry out activities such as picking up laboratory equipment and metering and pipetting liquids. The robot has an action radius of 1.5 m. According to the company, this area can be increased by several meters using a linear unit.

LASERS,SENSORS, OPTICS

CEA, CNRS Developing Laser Ablation Technology

91WS0326A Paris L'USINE NOUVELLE in French 11 Apr 91 pp 84, 86

[Article by S.F.: "Laser Ablation for Materials Analysis"; first paragraph is L'USINE NOUVELLE introduction]

[Text] Combining laser radiation and spectroscopy facilitates the basic analysis of solid materials. Those primarily concerned by the technique: the metallurgy-steelmaking and glass industries.

Is materials analysis the new Holy Grail? Grail, in any case, is the translation of the French acronym GRAAL, which stands for Research Group on Laser Ablation Analysis. The group includes the CEA (Atomic Energy Commission), the CNRS (National Center for Scientific Research), and six manufacturers—Sollac, Pechiney, Renault, Saint-Gobain, and the analysis-equipment manufacturers Jobin-Yvon and Dilor. The five-million French franc [Fr] project, which is supported by the Ministry of Research, will last until 1993.

The eight partners joined forces in 1989 to develop this technique for basic analysis of solid materials. The method has been known for at least a good 10 years. The CEA has been working on it for five years, originally for a specifically nuclear application: monitoring the vitrification of nuclear waste. The recent progress made in laser reliability has renewed interest in laser ablation, which consists of vaporizing a solid material by striking it with a laser beam. The plasma that is produced is then analyzed with a spectroscope, enabling researchers to determine its basic composition and study its behavior.

"The chief value of the method is that laser ablation interacts on different types of material, whether insulating or conductive," explains Patrick Mauchien, head of the GRAAL project at the CEA's Analytic Laser

Spectroscopy Laboratory (LSLA). Ferrous and nonferrous metals, glass, and composites can be analyzed in this way directly, without being placed in a solution. In addition, the use of lasers would make it possible to perform analyses from a distance, by moving the laser beam through optical fibers. Another valuable feature is the possiblity of monitoring melting materials: This is what motivates steelmakers and metallurgists such as Sollac and Pechiney.

In fact, GRAAL is pursuing two lines of research. In the first, the vapor created by the laser is transported and atomized in an inductively-coupled argon plasma (ICP), which is then analyzed by spectrometry. In the second, the plasma is directly studied by the spectrometer (this is called direct ablation). This technique is very tricky, for controling plasmas in the air involves complex physical phenomena. So the LSLA has developed two devices, one using a Jobin-Yvon ICP spectrometer, the other a multi-channel Dilor spectrometer.

The initial experimental stage, which was conducted in 1990, evaluated the method's performance. It proved that the use of an excimer laser emitting in the ultraviolet spectrum produced better results than a YAG in infrared. In 1991, GRAAL will work on the reproducibility of the analyses; it hopes to begin designing a complete piece of equipment soon. Moreover, France is not the only country to study laser ablation. Thyssen in Germany and British Steel in Great Britain have launched research programs. And the Japanese company Nippon Steel has announced it will install a system in 1991.

France: ONERA Develops 3-D Laser Camera

91WS0312A Paris L'USINE NOUVELLE/ TECHNOLOGIES in French 21 Mar 91 p 21

[Article by Marc Chabreuil: "3-D Laser Imagery Misses Nothing"; first paragraph is L'USINE NOUVELLE/ TECHNOLOGIES introduction]

[Text] The Tilt telemetric camera sees in the dark and through flames, while snapping pictures at the rate of 25 a second. It is a high-performance detection and monitoring device.

Tilt is a miracleworker: a telemetric camera that is totally insensitive to the amount of lighting. It "sees" in three dimensions in both total darkness and through flames, and can monitor a fire or welding operation in real time. It may be adopted for use on mobile military robots as well as the future Martian "rover."

Developed by ONERA (National Office of Aerospace Studies and Research) with the assistance of DRET (Directorate of Technical Research & Studies), the Tilt (Three-Dimensional Laser Imaging Technique) camera uses a diode laser that continuously emits an infra-red beam (0.83 μm). The beam is power modulated at high frequency. Horizontal scanning is performed by galvanometric mirrors oscillating at 4,000 Hz. Two PIN diodes (with a field of 10 or 20) detect the signal reflected by the target: The signal is then amplified and processed, giving the reflectance image in proportion to the albedo. The phase shift between the signals emitted and received furnishes the distance for each point within 10 mm. By converting it into an intensity or chromatic signal, relief can be depicted up to 20 meters away (50 meters by 1993, thanks to avalanche photodiodes), with field depth of 2.14 meters (this will be increased to 20 meters this year). Tilt's first great feature is its picture shooting rate of 25 images (256 X 256 dots) a second. Another strong point: "Since the beam is power modulated, only that modulation is detectible. So no continuous stray light is seen," says Jean-Pierre Cariou, head of ONERA's optronics systems group. The prototype, which was just presented to a NATO congress, offers optimal performances. Depending on the desired application, one function (picture-taking rate, resolution, range, etc.) can be enhanced at the expense of the others. "With those adjustments in mind, Tilt is made of autonomous and interchangeable modules and its present volume leaves a lot of room for possible modifications," confirms Jean-Pierre Cariou. So if manufacturers want a tailor-made Tilt, they have only to make their needs known.

Germany: Self-Propagating Free Electron Laser Developed

91WS0246B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 11 Mar 91 p 10

[Article by re.: "Free Electron Laser for New Applications"]

[Text] The Institute for Nuclear Physics at the Darmstadt Technical Institute is to begin using a free electron laser developed by the institute. The device produces a continuous laser beam which is generated by means of free electrons. As reported by Prof. Dr. Achim Richter and Dr. Harald Genz of the Institute for Nuclear Physics, the basic precondition for realizing this project is an electron accelerator with beam properties such as those of the new superconducting S-Dalinac electron accelerator in Darmstadt which began operating in 1990.

The free electron laser gets the electron beam as a necessary nutrient from this electron accelerator. It runs through a 2.6-meter-long special magnet device, which is called an undulator and which is the centerpiece of the free electron laser. In the case of the Darmstadt laser, the radiation achieved in the undulator region lies in the infrared wavelength spectrum. By means of a suitable mirror in front of and behind the undulator, the beam can travel back and forth in a resonator. It is reinforced through subsequent electron pulses. As a result of this process, a coherent, finely bundled and pulsed laser beam becomes available, which has a variable wavelength and could thus open up new application areas.

According to the Darmstadt Technical Institute, this project not only improves the technology of the free

electron laser, but it will also become a valuable instrument for basic research in many areas and for technical applications, for example in medical technology. The first area in which it will be used at the Institute for Nuclear Physics is in basic research, in the fields of applied and solid state physics. Among other things, laser-supported crystal growing, which is an important problem for materials research, will be studied.

With this project, supported over three years with a 5 million German mark grant from the Federal Research Ministry, the Darmstadt scientists have reached the top of their field in Europe, according to their own assessment. Work is also underway on similar projects in Rome, Paris, Utrecht as well as in Japan and the United States.

Germany: BMFT Funds Application-Specific Sensor Research

91WS0308A Duesseldorf VDI NACHRICHTEN in German 22 Mar 91 p 31

[Article by Franz Miller: "Sensors From the Box of Building Blocks; first paragraph is VDI NACHRICHTEN introduction]

[Text] The new semiconductor technology from the microelectronics field will revolutionize manufacturing technologies over the next few years and create new mass products. The first results of a joint project to develop application-specific microsensors show how small and medium-sized enterprises, in cooperation with a research institute, can prepare for the sensor market of tomorrow.

Annual average growth rates of about 9 percent will more than double the world market for sensors from 30.8 billion German marks [DM] (1990) to DM71.9 billion in 2000. As sensory organs, sensors will become the key to additional progress in processing technology and in machine building.

Microsensors offer considerable advantages over conventional sensors through the integration of a sensor with microelectronic signal processing and micromechanical components on one chip. In comparison with single manufacture of most sensors based on precision engineering, serial manufacture of semiconductor technology lowers the unit price considerably. But the production of such new microsystems will be difficult to solve for the supplying industry which consists mostly of small and medium-sized companies, since the new semiconductor technology requires substantial investments and extensive know-how.

In order to be able to maintain a connection with this key technology, the Federal Research Ministry [BMFT] has established a Microsystems Technology development program and has made DM400 million available from 1990 to 1993. The program was accepted by the economy surprisingly quickly, according to Dr. Joerg Linders, responsible for the Micromechanics section at VDI/VDE Technology Center for Information Technology in Berlin, which is entrusted with the projects. For 1990 alone, 472 applications worth a total of DM137 million were submitted.

One year later, fruitful results have already been presented from one of the first joint projects to implement application-specific microsensors for mechanical dimensions, in which the five medium-sized companies, one large enterprise and the Fraunhofer Institute for Solid State Technology (IFT) in Munich cooperate.

"Which pressure sensor do you need?" Peter Groth of the software producer T-Programm begins his questions during a demonstration of the simulation program. And with every answered question regarding geometry, technology and parameters, and with every click of the mouse, by means of the menu another component is created for the design of a desired sensor. At the end, the three-dimensional model appears on the monitor. Although the simulation tools for sensor design are not yet complete, the capability is still impressive. Basically, this is to enable even small enterprises to have a universal, automated design of every kind of pressure sensor. In addition to the considerable reduction in development cost, it has the advantage of independence and protection of know-how, because at less than DM50,000 including hardware the design tool will be affordable even for small companies.

The basis for development of the simulation tool is a program introduced by T-Programm GmbH which works with the finite element method (FEM). All analytic data necessary for sensor design, the geometric models, the mechanical simulation, will be worked out by the Fraunhofer Institute for Solid State Technology and implemented in the program. "Such tools are of extraordinary importance especially for small companies even if they are manufactured somewhere else," project leader Dr. Hermann Sandmaier of the IFT explains the important function of the tools. "With this the time span between product idea and technical realization can be significantly reduced and the competitive ability thus increased."

Integration and combination of sensors with microelectronic circuits is the goal of a part of the project, in which one family of integrated pressure and acceleration sensors are being developed as CMOS cells (ASICs [application-specific integrated circuits]). CMOS technology is used because it is widespread, mature and can be handled even by medium-sized enterprises. For this, piezoresistive sensor elements must be used as analog standard cells. On the other hand, the standard cells must also be adapted to the sensor elements, so that they harmonize with the temperature behavior or the power supply. Finally, the cells are to be integrated into the ASIC cell library.

The objective in developing the manufacturing process is to alter the CMOS process as little as possible. Various test chips with integrated sensors have already been

developed at IFT. The cooperation partner for this portion is the international ES2 company with branches in Munich, London and Paris. "ES2 was one of the first ASIC manufacturers to use mixed analog/digital designs and to be successful with it. Now, we want to expand the limits of the system by integrating sensors with ASIC. We see a promising, growing market in this," says Dr Riedlberger at ASIC producer ES2 in order to underline the economic dimension of the development work. Sensor elements and sensor-specific analog and digital cells are to be developed, which can be fully integrated into the existing library system. The first cells and experimental chips have already been designed.

In the manufacturing technique, the process in which the wafer is etched on only one side must be supplemented with new methods for etching the reverse side, which is needed for the production of pressure sensors. Only with this method of etching would it be possible to produce membranes, grooves and other three-dimensional formations in micromechanics; they are being developed by IFT until they are ready for the industry. After three years the cell library, enriched with the sensor elements, is to become available to the user, and these designs of ASIC's will be possible to carry out.

Another focal point for the joint project is trying to solve the problem of complicated installation and interconnection technology. Sensor chips of single-crystal silicon—in principle microsensors can be made from all semiconductor materials—are reliable and resistant to wear, because silicon is very elastic and in manufacturing by etching no deformations or tensions are imposed on the material. Potential problems are also assembly-conditioned, because tensions occur at the connection between the sensor chip and the package. For this reason a stress-free assembly method must be developed which minimizes tensions and which is simple, inexpensive and universally usable. In order to reduce tensions during assembly, a silicon adapter is inserted between sensor chip and package. Various designs for adapters have been designed and tested for tension at IFT. The optimal solution was found to be a folded structure, with which 99 percent of the tensions can be compensated for by deformation.

In a second step, the etching processes for the manufacture of the folded structure are now being further developed. In the end the wafers are to be connected with each through "anodic bonding." But since such a wafer bond facility so far cannot be found anywhere on the world market, the Munich special machine builder Plasmos has taken over the design of such a facility. A prototype will begin test operation as early as the middle of the year. With that, the product cycle from design to a chip assembly method that can be handled by one company has been closed.

The seven joint partners are already quite certain that they can further develop the necessary microtechnologies into a sufficient degree of maturity. The group is kept together by the committed Microtechnologies and Systems section at the Munich Institute for Solid State Technology.

MICROELECTRONICS

French Company To Build 100 kW Chemical Heat Pump Prototype

91WS0292B Paris INDUSTRIES ET TECHNIQUES in French 8 Mar 91 p 67

[Article by Cecile Remy: "Cooling by Chemical Means", first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] Four licensed companies are commercializing the chemical heat pump developed by CNRS [National Scientific Research Center] and Elf Aquitaine. A clean process, without CFC [chlorofluorocarbon] or substitute.

The chemical heat pump has left the laboratories. Five refrigerator vehicles equipped by Faiveley will test it in 1991. Quiri, which specializes in industrial refrigeration, plans to build a 100kW prototype. Germany's Dornier is combining this technology with solar collectors for refrigeration and environmental control systems. And Sofrigam is developing portable refrigerators. These four companies have acquired licenses to commercialize the STELF [Elf Thermochemical System] process developed by France's Elf Aquitaine and the CNRS's Institute of Science and Engineering of Materials and Technologies at Perpignan.

Production and Storage of Heat

The STELF process is based on the exothermicity of the chemical reactions between a solid and a gas. Heat is released when the gas reacts with the solid to form another gas, and heat is absorbed, producing cold, in the inverse sense. Thus, the principle is equally applicable to the production and storage of cold and of heat. The gas is ammonia; and the solid is an expanded graphite encompassing salts—calcium chloride or manganese chloride, for example.

Manufactured by Carbone Lorraine, this reagent has the advantage not only of being a conductor and very porous, but also of being easy to use: 1 kilogram of reagent, with a storage capacity of between 450 and 700 Watt-hours, supports the operation of a machine with a power rating of approximately 1 kilowatt for approximately half an hour.

Several reactors are interconnected. The transfer of gas from one to the other takes place in accordance with the temperature and pressure differences among them. The starting thermal energy is supplied by a heat source: for example, a gas or fuel-oil burner, an electrical resistance or solar collectors, or even energy having no commercial value. For applications where continuous production of energy is needed, the system includes four tanks interconnected as individual pairs, each pair operating 180

degrees out of phase with the other. Thus, configurations vary according to continuous production and storage requirements.

The system uses no CFC, is clean from an environmental standpoint, and stands to compete seriously with compression techniques. It can operate throughout a temperature range of between -50°C and 350°C, versus 0°C and 220°C for adsorption based on zeolite, and less than 150°C for liquid gas absorption systems. The STELF system is also cheaper and more efficient than the Japanese chemical heat pump based on the use of rare earths and hydrogen.

Although the first licensees are using STELF to produce cold, other applications are feasible. In particular, a EUREKA project has been submitted for the air conditioning of buildings. Elf Aquitaine is prepared to concede other licenses.

French Company Presents 'Clean' Circuit Soldering/Cleaning Machine

91WS0298D Paris INDUSTRIES ET TECHNIQUES in French 22 Mar 91 p 69

[Article by Ridha Loukil: "Electronic Circuit Boards: Exit the CFC's [chlorofluorocarbon]"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] Circuit board assembly has made peace with the environment. With Soltec's machine for soldering in an inert atmosphere, there is no longer a need to clean the circuit cards, and consequently, no need to use CFC's. The user not only solves the problem of the infamous chlorofluorocarbons accused of destroying the ozone layer, but also saves on cleaning equipment.

The use of CFC as a solvent for cleaning circuit boards is tied to the use of more flux than needed for the solder itself. These fluxes are chemical products deposited on the card by pulverization. They serve first of all to strip clean the solder points and the composite plates to assure the adherence of the solder. Next, they prevent the oxidation of certain metallic elements during the preheating which prepares the card for the soldering operation. Finally, they guarantee the quality of the solder by retarding oxides and undesirable particles brought in by the wave of solder. Indeed, part of the flux remains on the circuit card. The cleaning serves to eliminate these residues which would interfere with the test.

Chlorofluorocarbons constitute an excellent cleaning agent, washing and drying in a single operation, in very simple installations. However, they are considered harmful to the environment and have become the object of stricter and stricter restrictions.

For the electronics industry, the problem takes on importance with the development of surface mounting. Here, the residues escape more easily into the air, hiding between the composites and the substrate. Faced with environmental constraints, the industry is exploring two courses. One substitutes the current fluxes with new, water-soluble fluxes, so that cleanup could be carried out with little or no CFC's. While this solution does not entail any modifications, it presents the inconvenience of requiring a purification station at the beginning of the assembly line. The other course involves using a solder in an inert atmosphere, a process which, by suppressing the risk of oxidation, eliminates the need for flux, making cleanup unnecessary. This is the course of action followed by the Dutch company Soltec, represented in France by the firm Jybac Technologie.

A Consumption Rate of 12 Cubic Meters of Nitrogen per Hour

Their machine looks like a tunnel 9.5 m long, with an airlock at the entrance, an airlock at the exit and a chamber for two soldering passes. All these modules are filled with nitrogen. It is the first on the market with an airtight soldering chamber, where the concentration of oxygen is kept below 10 ppm. The circuit board enters the solder chamber only after the entry airlock is evacuated and filled with nitrogen twice. By the same token, it does not pass to the exit airlock until that has been twice evacuated and filled with nitrogen. It files through the interior of the tunnel automatically every 30 seconds.

Twice as expensive as an open-air soldering machine, the Soltec machine consumes more than 12 cubic meters of nitrogen per hour. The basic model costs 1.4 million French francs [Fr], the version with the most outfitting about Fr1,800,000.

A prototype machine was installed at Philips in Eindhoven in the Netherlands. It is also undergoing trials in Germany at AEG in Nixdorf and Sel (Alcatel).

TELECOMMUNICATIONS R&D

EC, Industry Agree on D2 MAC Standard

91WS0325A Paris LE MONDE in French 26 Apr 91 p 28

[Article by Philippe Lemaitre: "Brussels Will Help Television Industries Move Toward High Definition"; first paragraph is LE MONDE introduction]

[Text] Under the aegis of the European Community, electronics manufacturers, satellite operators, and television stations have reached a compromise on introducing the new television standards. Brussels will provide financial help for a gradual shift from PAL [Phase Alternation Line] and SECAM [Sequential Color and Memory] to European high-definition television.

"We've got the agreement." Mr. Felipo-Maria Pandolfi—European Commission vice-president and sponsor over the last several months (see LE MONDE 30 March) of the conversations among the different parties concerned by HDTV—was jubilant. Relations between the different industry players, once freed of their mutual distrust, should make it possible to get off to a good start

again in the HDTV race against the Japanese that the Europeans began four years ago. And, in so doing, provide a shot in the arm to the Community's electronics industry, which sorely needs one.

"We've won. From now on, Murdoch talks and deals with Gomez and Timmer[1]," exclaims Mr. Pandolfi. The Commission's vice-president, who made his comments outside the context of a meeting of the Twelve's research ministers, was visibly anxious to show that the Commission is determined to act—both here and in the field of semiconductors—to prevent the European electronics industry from going under. Actually, his concerns on that score are a bit premature. "We should have a draft agreement in hand by next week. The practical modalities—timetable and the rest—still have to be spelled out, but politically, it's done."

The proposed solution has two components. One is legal. The Twelve will extend the European directive requiring the use of D2 MAC for satellite transmissions, while broadening its scope to include medium-power satellites (those most used by private stations). It is understood that this restriction would only be applied gradually. The second component is private: Manufacturers, television broadcasters, satellite operators, and program producers will create a consortium to promote the European standard and the equipment that supports it[2].

Stations now broadcasting in PAL and SECAM would promise to gradually begin transmitting in D2 MAC; manufacturers will do what is necessary to bring out the new equipment, particularly 16/9 screen sets, in time, in sufficient quantity, and at a good price; producers will step up the number of programs shot in D2 MAC. And the whole television aristocracy will be helped to keep these promises by the European budget. The inter-industry agreement that is being looked at—"it would involve written commitments," says Mr. Pandolfi—will be effective for five years, and renewable.

Examples of how the Community's assistance will be used include partially subsidizing the cost of shifting from D2 MAC to HD MAC, which is the final standard, and bringing cable operators into the picture[3]. Mr. Pandolfi also plans, still for the sake of enlarging the D2 MAC and 16/9 set markets, to grant subsidies to spur Hertzian operators to join the consortium as well: a way of finally convincing "his friend Berlusconi" of the MAC family's merits.

Footnotes

1. The respective CEO's of Thomson and Philips.

2. The leaders assembled in a Eureka project are Thomson, Philips, Bosch, and Nokkia.

3. The European high-definition television standard is called HD MAC and will be available toward the middle of the decade. The interim standard, D2 MAC, already offers viewers appreciably better picture and sound quality.

German Telecommunications Developments Reported

Videophone Under Development

Heidelberg NET—NACHRICHTEN ELEKTRONIK + TELEMATIK in German Mar 91 pp 70-72

[Article by Dr. of Engineering Hans-Peter Quadt, DBP Telekom, General Directorate, Bonn: "The Telephone of the Future"]

[Text] In the middle of this year, Deutsche Bundespost Telekom will introduce its videophone service. It will then offer communication through speech and image based on the integrated services of the digital network ISDN. While, due in part to the high cost, the equipment to begin with will mainly be used in the business sector, videophones will already be available within a foreseeable future for private customers as well. The development of the demand will play a major role in this.

As early as the beginning of this century attempts were made to combine telephone and image transmission. The tele-vision-speech service between Berlin and Leipzig in 1936 was an example of this. These initial efforts failed, however, because of the high cost.

Not until the 1980's did the preconditions improve because of the enormous progress in digitization, the resulting networks and a universally recognized international standardization. Meanwhile, the CCITT (International Telegraph and Telephone Consultative Committee), in close cooperation with scientists, has developed international standards for the videotelephone—for the coding method (H.261), the framework structure of the protocols (H.221) and the protocols (H.242). These standards are used worldwide in order to develop videophones. An important precondition for international videophone service as an expansion of the worldwide telephone service has thus been met.

The Technology of the Videophone

The transmission of moving color images, as we know them from television, needs more than 2000 times the bandwidth of a normal telephone line. As long as the costs for wideband transmission cannot be significantly reduced, economical transmission of moving images can only be realized through a reduction of the information content at the source. The foundation for this is complicated mathematical coding rules.

Some of the most important elements of the reduction are:

- The differential formation between subsequent image contents; unchanged image contents, such as the background, are only transmitted once;
- The differential formation between neighboring parts of the image (blocks); here as well, unchanged portions are only transmitted once;

- The variable coding: often recurring information blocks are transmitted with short code words, others with long ones.

Simultaneously, the spatial resolution on the screen is reduced to one-quarter; the sequential speed of 25 images per second for television is reduced to about 10 images per second. These changes are compatible with the anticipated use of the equipment, however, since the demands in general are lower in this area than, for example, for cowboy movies or sports events on television.

One consequence of this, however, is that images and portions of images must be stored and recombined into an image by extensive computing procedures. This takes time and requires a highly integrated technology. In order to achieve processing times of fractions of a second for all the computing operations, digital signal processors must be used, which in their complexity make full use of today's technical possibilities of several hundred transistor functions per chip.

Three-Step Introduction Concept

As early as 1987 DPB Telekom developed a three-step concept to introduce a videophone service.

The first step of a "functional sample" was successfully concluded in early 1989. Within the framework of an international tender, seven German companies delivered four videophone prototypes each. With these units, manufactured individually in laboratories, it was possible to demonstrate that transmission of moving color images is possible in parallel with language by means of the available technology through ISDN. Presentation of these functioning samples at trade fairs and exhibitions has made it clear that there is major interest in a videophone. Thus, the usefulness of this which extends beyond the conventional telephone conversation, is not in doubt. Since this form of communication is still unusual and new, many interested persons have no actual experience with it. That is not so in a test carried out by DBP Telekom together with the Integrata company and Philips Kommunikations Industrie. In this trial the videophone is being tested with an additional document camera in the working environment. After initial skepticism, the use of it has proved itself, so that additional equipment was installed in a second step.

In the second "First Equipment Generation" phase DBP Telekom is obtaining a large number of videophones in order to offer them to its customers and to build up the videophone service with the customers. With these approximately 500 units it will be possible for the first time to realize communication with speech and image in a digital network that is already available in many regions, the ISDN. What until now has only been possible in the preliminary wideband network (VBN) with videoconferencing, is to be made available through the work in the second phase to anyone as a general service after the mid-1990's.

The third "Series" phase begins when series-manufactured videophones are being offered with full international compatibility. The diversity of the equipment will be adapted to the customers' requirements. In particular, experience from the second phase of the Telekom concept will help create the preconditions for an economic and market-adapted form of videophone service and end equipment.

Special Operation in Five Cities

DBP Telekom plans to introduce the videophone service in mid-1991. This introductory phase will be marked by first-generation videophones and promotion measures by DBP Telekom. The newly founded special operation Image and Wideband services (SpV BBD) occupies a key position here.

In this first phase the videophones cannot yet be produced in large numbers. Like all other end equipment after 1 July 1990, they will be available for purchase, rent and, presumably, for leasing, on a competitive basis. The prices will still be high during this first venture into this field. A selection of three different units will be available.

In order to learn as much as possible from the experience gained with these videophones, DBP Telekom intends to accompany the introduction of this service with a promotion program. Every customer who acquires or rents a videophone can apply for a subsidy for his use of the videophone or for his investment. In a separate contract is set out that he will pass on his findings and experience, for instance in a monthly report, in return for the corresponding remuneration. The intention is to keep the compensation lower than the purchase price, so that the customer's own interest in using the videophone is guaranteed. In special cases, exceptions may be made to this.

Processing the support measures and the purchase orders or rentals of the videophone will take place through the special BBK department. In five cities in Germany (Berlin, Duesseldorf, Hamburg, Karlsruhe, Munich) sales groups will be established which will work especially with videocommunication. In the initial phase, the questions that arise will still be so complex that Telekom officials, for example in telephone stores, will transfer customers to the special department. This applies primarily to questions which [illegible] concept. Purchase or rental of a videophone should be possible in any telephone store, however.

DBP Telekom already today offers videocommunication in the form of videoconferencing. In addition to self-dial-capable transmission with television quality (140 Mbit/s) and reserved connections according to the CCITT standard of H.120/H.130, videophones represent a third category of image communication.

Overall Concept for All Image Services

Triggered by the international standardization and potential self-dial capability even for 2 Mbit/s, DBP Telekom is presently working on an overall concept for image services. Customer demands for quality and additional performance characteristics are to be embodied in this project. The coupling of various local end points is the most important element here.

At the European level a group of experts is working on actual implementation of the standard. Technical tests to couple the digital network and end equipment are being carried out, as are market studies for a European videophone experiment with companies and, in some cases, private persons active in the European region.

The sum total: After efforts at the beginning of the century to supplement the telephone with a picture, the 1980's delivered the technical preconditions for an international videophone service. In 1991, DBP Telekom will introduce its videophone service, accompanied by a promotion concept. In the mid-1990's, mass-produced equipment will be offered to private users as well.

Status of Eastern Laender

91WS0293B Heidelberg NET—NACHRICHTEN ELEKTRONIK + TELEMATIK Mar 91 pp 73-75

[Interview with Gerd Tenzer, member of the DBP Telekom board of directors, by NET; "There Are No Sensible Alternatives to Our Concept"]

[Text] In order to get the economic and social development in the five new Bundeslaender going, what is needed is above all a well developed telecommunications infrastructure. DBP Telekom is trying to master this task with billions of German marks [DM] in investments. In an interview with NET Gerd Tenzer, a member of the DBP Telekom board of directors, explains Telekom's strategy. At the same time he takes a position on the criticism which has been voiced in this connection from various sides.

NET: In September 1990 DBP Telekom presented the TELEKOM 2000 project. In November followed the turn-key projects. Has the level of telecommunication in the new Laender noticeably improved already based on these projects?

Tenzer: Immediately after the opening of the wall, we began to undertake all the measures needed in order as quickly as possible to establish a powerful and forward-oriented telecommunications network in the new Laender. The buildup is laid down in the strategic Telekom 2000 concept, which is designed for the long term. Within the framework of this concept, more than 95,000 new telephone connections and about 1,300 public coin telephones had been installed by the end of 1990, and more than 6,000 lines had been switched on.

To this extent the telecommunication could be considerably improved as compared to the pre-existing, catastrophic situation at the beginning. Based on the explosive demand for telephone connections, particularly on the part of business customers and government offices, and due to the precipitous rise in communication, it is not yet possible to expect any noticeable improvement after such a short time. Conditions will clearly improve over the course of the year, however.

NET: What detailed measures are planned for 1991?

Tenzer: Another 22,000 new lines will be taken into operation and more than 300,000 main connections installed. Further, the digital overlay network will begin operation and the first turn-key projects will be completed. The turn-key auxiliary program includes 32 projects, which are to be given to four principal customers as a ready-to-use comprehensive package with an additional total of 244,000 switching units. For example, our contractual partners are building the entire infrastructure in a city or a smaller region for a certain number of subscribers, from the subscriber hookup in the house to the connection to the long-distance network. The investment volume for this is more than DM1.5 billion. Half of these projects are to be finished by mid-1991, and the remainder by November 1991.

NET: The association of postal users is of the opinion that DBP Telekom improvises too little and is holding things up with planning. Did the expansion of the telecommunications infrastructure take too long to get going and is it still doing so?

Tenzer: In view of the technical complexity, the large investments and the multitude of the influence factors of a modern telecommunications network designed for the future, it would be an error that could only be repaired with great expenditure of time and money if we were to do without a minimum system and improvise in an uncoordinated way. Directing all the measures toward a basic plan is absolutely necessary, so that the effected investments are sensibly interlinked and are able to produce a rapid effect.

The planning for a target network which can meet the anticipated demand in the new Laender by 1997 was therefore produced as early as the middle of 1990. The necessary programs are in the process of being implemented, so that this network will largely be completed as early as 1991 and 1992. Beyond that, we are trying to accelerate the expansion in an unconventional way, through far-reaching modification of our regulations and through improvisational measures, particularly in the interest of the developing businesses.

NET: What has priority? Improvisation or basic planning, or the creation of an organizational structure?

Tenzer: DBP Telekom follows a "both-and-strategy." In the interest of rapidly meeting the demand, improvised measures are used everywhere it is sensible as well as possible for reasons of time. At the same time, however

an efficient organizational structure must be established with which this powerful buildup work can be assured. That is why, as early as November 1990, we set up a total of 15 new telecommunications offices and five new directorates. In order to support the key areas, particularly the planning groups, experienced forces from the old Laender were sent as advisors to the new telecommunications offices. Furthermore, the advanced training of the skilled workers in the new Laender is proceeding with high priority.

NET: Do the companies involved in the turn-key projects in fact have the necessary capability for network planning and expansion? Are there, for example, bottlenecks in the installation of switching centers?

Tenzer: The participating general contractors have given binding assurances that the projects will be carried out to the required extent and within the time frame. In order to assure the necessary performance, it was agreed, among other things, that medium-sized enterprises, above all, in the former GDR should participate in carrying out the projects as subcontractors. Furthermore, we give the principal contractor extensive freedom of movement in the implementation. He also gets the opportunity to work on the various, heterogeneous performances in multifunctional project teams. In my opinion this creates optimal conditions for keeping to the tendered completion schedule.

NET: Are additional Telekom tenders (communications satellites, Bundeswehr resources, etc.) being accepted to the anticipated extent?

Tenzer: The DIVA, DAVID, DASAT satellite services, the radio relay segments, the Mobilfunk-C cellular network, etc. are the only possibility for establishing additional telecommunications capabilities in a short period of time. They are also in great demand. It was also agreed with the Bundeswehr that it should let us use its cable connections, radio relay segments and telecommunications installation capabilities in order to build the network. These resources are being used as far as possible.

NET: Telekom is already the largest investor in the new Bundeslaender. Apart from the billions in investments within the Telekom 2000 project, 1.5 billion are to be invested in the turn-key auxiliary program—not to mention new projects in western Germany. By freely awarding ready-to-use projects to industry, the principal contractors are also given a great deal of freedom. How can the buildup of the telecommunications infrastructure in the former GDR be financed and controlled in view of these dimensions? Are the costs even acceptable from a commercial point of view?

Tenzer: With about DM6.9 billion, Telekom is in fact the largest individual investor in the new Bundeslaender. It thereby makes an important contribution to the economic upswing in eastern Germany. Our total investments this year will reach an absolute record level of DM29 billion. In order to balance the budget, Telekom has to incur new debt in the amount of DM14 billion this year.

After an internal balancing of the books with the sister Post Office companies, we expect a profit of DM700 million, which corresponds to only half of the anticipated actual result of last year. The overall high debt burden for the company can primarily be traced to a disproportionately large increase in restructuring and buildup costs in the new Bundeslaender.

NET: These major investments in eastern Germany will undoubtedly be a heavy burden on DBP Telekom in the next few years as well.

Tenzer: Correct. But I'm also convinced that our investments will balance out in the medium term and that there is no alternative to our concept of accelerated buildup of an efficient telecommunications network. Additional investment activities by western enterprises, which are of decisive importance to the economic upswing, are only going to be initiated with the rapid expansion of the telecommunications infrastructure.

NET: Will the size of the accruing costs have any effect on the evaluation of services that are running deficits (for example Btx [videotext])?

Tenzer: The high investment burden in eastern Germany and the evaluation of deficit-ridden services are to be considered totally separately from each other. As I already mentioned, there is no alternative to our strong investment involvement in eastern Germany. It is a matter of expenses in a monopolistic field which we are also obligated to undertake because of our legal mandate and which we expect will be covered by returning proceeds in the medium term. With this new investment we are creating the necessary preconditions for our future competitiveness.

Independent of that, we evaluate our competitive services according to commercial and business-political aspects. It is our goal to offer an attractive range of products with a high standard of quality, oriented toward the various needs of private and business customers, and at current prices. In so doing we must always see to it that this range of products pays for itself.

NET: The turn-key program foresees an expansion of telecommunication at the economic centers. Will this not create the danger that the entire rest of the area of the former GDR will be at a disadvantage for years?

Tenzer: Our Telekom 2000 scheduled program envisions comprehensive expansion of the telecommunications infrastructure in the new Bundeslaender, in which the focal points initially are at the economic centers. In areas where our capacities are not sufficient, but where, particularly on the part of business customers, there is urgent need for telecommunications services, turn-key projects have been planned.

Altogether, these measures will lead to a noticeable improvement in the telecommunications conditions because the newly created network will increasingly take the load off the existing network. Over the next few years we will, beginning from the economic centers, push into the surrounding region in our network building and so create balanced service.

NET: Additional crash programs are needed in order to save the taxpayer additional losses in the amount of billions. Are more projects planned?

Tenzer: We have used all the required measures which make sense and are economically feasible. Our capacities and those of the electrical engineering industry are fully utilized at the moment, so that no additional crash programs can be undertaken in 1991. We are, of course, studying the possibility of achieving short-term improvement after 1992 by means of additional special programs.

NET: In view of the tasks that have to be mastered, various sides are demanding that the telecommunications monopoly should be abolished, at least for the region of the former GDR. Could such a step not in fact lead to a faster solution of the problems?

Tenzer: I am firmly convinced that we have exhausted all resources—including the electrical engineering industry—in order to improve the poor service situation even in the course of this year. Thus, I don't see any necessity to lift DBP Telekom's operating monopoly in the five new Laender. Apart from the question of what is the point of having two kinds of rights in Germany, I am firmly convinced that such a step would not contribute to improving the situation.

NET: Will the private network operators—for a limited time—get the opportunity to transmit speech?

Tenzer: That is a question which you must direct to the Federal Postal and Communications Ministry. However, anyone who demands of us that we continue to undertake all the infrastructure measures at enormous investment cost both in the western part of Germany and particularly in the eastern Laender, and that over the next four years we earn an additional DM8 billion as yet another contribution to financing German unity, he should be interested in maintaining the financial strength of the DBP Telekom.

BERKOM ISDN Project

91WS0293C Heidelberg NET—NACHRICHTEN ELEKTRONIK + TELEMATIK in German Mar 91 pp 76-81

[Article by Juergen Kanzow of the Technical Center, Berlin, DETECON GmbH: "Thinking in Contexts;" first paragraph is NET introduction]

[Text] In 1985, the Deutsche Bundespost decided to venture onto new paths and concern itself extensively with the user side of a future wideband ISDN [Integrated Services Digital Network]. In 1986, in agreement with the Berlin senate, it started the Berkom project. Even today, more than two years before the project is to be concluded, the first results can be seen.

Since 1977 the Deutsche Bundespost has been intensely involved in fiber optics technology and the possibilities of using it as replacement in telecommunications networks. At that time the new technology began to be tested in practical experiments. In these experiments, which were usually carried out in Berlin, the emphasis from the outset was on application in the local network and furthermore at the subscriber hookup. This network area is technically and economically decisive when it involves the introduction of new wideband telecommunications services and the transition to an integrated telecommunications network which combines all telecommunications services.

Who Needs a Universal Network?

Proving the technical feasibility of such a universal network, in which all telecommunications services are transmitted over a single physical (fiber optic) subscriber hookup, succeeded in the BIGFON (Wideband Integrated Fiber Optic Local Telecommunications Network) tests, which began in 1983 in Berlin and six other cities in the FRG. From that point in time on, it was clear that from a technical standpoint it would only be a few years until the transition from copper cable to fiber optic cable and from separate networks to an integrated network. The time period would essentially be determined by predictable technical development steps in digital technology and in optical electronics. It was considerably less clear, however, which users and applications would utilize the wideband services of a future wideband-ISDN or an Integrated Wideband Telecommunications Network (IBFN).

In view of the large investments and the many years required before building a new telecommunications network such as the ISDN-B, the question of utilization of such a network very quickly became the key question, because on the one hand one could not justify starting to build such a network without knowing who would use it or to what extent and after what point it would be used. But neither, in view of the long installation time, was it justified to postpone an infrastructure measure of such potentially major economic importance until demand for the services became urgent and then could not be met for years.

In this situation Deutsche Bundespost in 1985 decided to concern itself intensely with the user side of a future ISDN-B IBFN. To this end in 1986 it began—in agreement with the Berlin senate—the BERKOM project (BERliner KOMmunikationssystem). The originally planned project lifetime of four years turned out to be too limited by the end of the detailed planning phase in late 1986, so that as early as 1987 an extension by two years until the end of 1991 was determined by the Federal Postal Ministry. In 1990 yet another extension

by one year was undertaken, in order to adapt the running time of the project to the running time of the RACE [Research and Development in Advanced Communications in Europe] projects Telemed, Telepublishing and ESP (EBIT Service Project), which are closely connected with Berkom, and which were not to be concluded until 1992.

Berkom will then have run for a total of seven years. Even today, more than two years before the end of the project, the first evaluation can be made, since the development initiatives within the framework of the present planning approach and project budget have been concluded and the results can be judged.

The Goal: Promote and Support

Berkom's objective is to promote and support the development of services, applications and end systems for the wideband-ISDN. It is not the development of network technology for ISDN-B with wideband transmission, fiber optics and optical transmission but the future utilization of this network which is in the foreground of the discussions. The wideband network which is available to the project as a Berkom test network is thus only a means of application development. Already it turns out, however, that in view of the greatly fluctuating existing technical development of wideband networks, application and network development cannot be as easily separated from each other as had originally (1985 86) been assumed.

In Berkom the Deutsche Bundespost for the first time took the step from purely network-related research and development to application-oriented research. The principal purpose of this was to assure the introduction of ISDN-B set for 1990 as well as the required investments by "tacking on" utilizations.

From experience with other innovation projects, it had become clear, however, that for the introduction of new telecommunications services it was no longer sufficient just to consider the immediate area of responsibility of the DBP, the network. Utilization of new services offered by telecommunications presumes the creation of an appropriate technical, organizational and financial overall system of network end systems, telecommunciation, application and users. In this context, the share of the network in this overall system is often of almost secondary importance.

Telecommunications services such as telephone, telex or fax with their comparatively simple structure from network and end equipment are in no way able to serve as the standard for introducing integrated telecommunications networks. The preparation of such networks required greater efforts on the part of the network operator. Above all, it is necessary to develop as deep a current understanding of the internal influence mechanisms of the overall system as possible. In this way the company's own contribution to the system can be inserted without points of friction.

Distribution in Percent of the Budget for the Various Project Areas (as of 9/90)

Application projects	32.80%
Service development, Standardization	6.91%
End systems	16.82%
Gateways	10.79%
Test network	29.46%
Market studies	3.22%

The Berkom Project Areas With the Individual Subject Specialties

Market Studies	Application Projects	Service Development	End Systems	Gateways	Test Network
	Telemedicine +RADCOM +MEDICON +PADCOM	Reference model for integrated services	Multimedia Workstation for Office Systems	Network adapter +Test network (STM ATM) +VBN	System studies
Demand potential Wideband communication	Telepublishing	+Scientific projects	Video workplace	Gateways +LAN (Ethernet, Token Ring, -Bus) +MAN (FDDI, DQDB)	Test network +fiber optic network +wideband-switching station STM ATM
Application-specific demands on multimedia office systems	Computer-integrated manufacture (CIM)	+Industry-Working groups RM I, II	Joint Editing		
	City planning	+International standardization			
	Wideband information systems +Berlin-Info +AKUBIS				
	Office systems +Central archives +Wideband-office communication (Apple)				

Financing From Three Sides

Plans for the Berkom project began with very general ideas about the assumed areas of concentration for using an ISDN-B. In addition to videocommunication, rapid text and data transmission were mentioned as potential wideband services, without it being possible to offer a more precise description of the applications. In the course of working out a more concrete program, talks were held with numerous telecommunications technology and data processing enterprises, as well as with research establishments in various fields, about defining the task of the project. During these talks the potential forms of wideband communication and their applications began to acquire more definite outlines.

At the beginning of the project, a multitude of different problems showed up. Not only was there no clear concept for the application of the future ISDN-B, but the standards and technology for wideband communication were also missing. Since, furthermore, actual introduction of ISDN-B was not anticipated until years later, Berkom initially seemed more a research program than a development promotion program. The problems mentioned also made it difficult for industry to participate intensively, since their product plans are normally carried out on the basis of more certain framework conditions than could be the case here. Even so, the project met with increasing interest in the industry—and particularly from telecommunications manufacturers. As early as the end of 1986 a program outline could be described, which included the fields of market studies, application projects, integrated services, end system development, network adapters, and gateways, as well as an ISDN-B test network.

In all, about 70 individual projects are involved, so that, as a matter of fact, one might rather speak of a "Berkom program" than a "project." A total of 78 partners from industry, scientific institutions and users participate in the individual projects. The financing comes from three sides. As the principal contractor, Deutsche Bundespost contributes the largest share, a total of about 190 million German marks [DM], in which the Land of Berlin also participates as an additional contractor. The funding for the scientific institutions is completely financed out of this budget, for which the industry pays up to half. The industry is thus helping to finance the Berkom project. This is to assure that only those project tasks are funded which the industry has a major self-interest in developing. If the self-funding of the industry in the amount of about DM125 million is included in the project budget, a total budget of about DM315 million is the result.

The major international companies are particularly heavily represented among the industrial partners. Their main interest is focused on the development of multimedia workstations and their connection to the ISDN-B, as well as on working out a reference model for integrated service based on the ISO/OSI model.

Cooperation Is Everything

In this project the German telecommunications industry is primarily involved in the network field. The Berkom test network has three wideband nodes—two STM (Synchronous Transfer Mode) nodes and one ATM (Asynchronous Transfer Mode) node, with a total of 76 subscriber hookups. The STM nodes permit space switching of 2 Mbit/s and 140 Mbit/s connections; the ATM node switches connections of up to 120 Mbit/s. In addition, a wideband information system for calling up films, photographs, music, speech and text is available, to which 16 terminals are presently hooked up.

More than half of the total of 78 partners in the project cannot be classed as industry but research and application. These numbers give no clue as to the extent of the participation; however, they do clearly show that Berkom is not supported by industry alone, but at least as much by the research field and the users. This cooperation of research, industry, post office and users is an essential characteristic of Berkom, because it is the first time that the participants in the innovation process have been brought together on a large scale and very intensely.

The development of a telecommunications network, end systems, services and application is taking place jointly and with constant feedback, so that bad developments can be recognized and corrected quickly. This does not involve just technical errors or technical friction points between the individual fields, but rather the nontechnical errors which are usually more quickly recognized and revealed by the user as a nonexpert when using the results of the development.

For the technical design of network and end systems it has also turned out to be useful to make overall optimizations possible. For example, a reduction in the transmission rate for videocommunication in the telecommunications network and the resulting cost saving can be immediately weighed against additional costs on the end equipment side (videocodecs). Further, the user can also judge whether the quality loss in videocommunication that might be connected with the bit rate reduction is at all acceptable to him. In particular the experience gained in this area provides very interesting indications of the problems of the traditionally very strongly network-oriented thought and behavioral processes of the network operators. It is their aim to view the technical and economic optimization solely within the network area and without taking end systems or applications in account.

When looking in greater detail at the individual project areas of Berkom, it can be determined that certain focal points have developed. In the application areas these are primarily Telemedicine, Telepublishing and wideband information systems.

Telemedicine and Telepublishing

Telemedicine deals with the technical possibility of sending digital images (X-rays, computer tomography

etc.) rapidly within and between clinics as well as to and from physicians. Most important in this field are improvements and changes which could develop in the medium term in organizing medical services.

The demands on the transmission speed of medical images is usually quite high, because on the one hand waiting times in practices are not acceptable and, on the other, the information content of radiological images is very high. An X-ray image, for example, may have an information content of 40 MB, for which network transmission speeds of 140 Mbit/s are by no means too fast. Just think of the other "time-consuming" elements of the overall communications process, such as the retrieval of an image from the matrix memory.

Besides, it turns out that the application possibilities as seen from today's point of view are restricted by the still limited performance of the end systems in telemedicine and not by the network. This conclusion is valid at least based on the boundary condition that the opportunities for individual communication provided by fiber optics technology are not significantly restricted by other network elements (such as transmission technology) or unsuitable network structures.

Telepublishing as well poses considerable demands on the performance capability of the network, since the quantity of information to be sent is even greater than for Telemedicine. To be sure, in publishing there are generally less strict time demands than when transmitting medical images, but this hardly has much impact on the network. A double magazine page with color photos, for example, has an information content of about 1.6 GB (for quality book printing with color photos it is far greater), the transmission time for which cannot be neglected even in very wide-band networks from the aspect of the overall production process (such as current news value).

When considering the market prospects for this and other currently discussed application fields in wideband communication, one must determine that the market potentials that can be reached—measured by how widespread the telephone is—are rather small, although it would be difficult today to meet a developing demand for wideband services by offering enough and enough good quality telecommunications.

Boost From Multimedia Systems

According to previous conclusions, the great demand for wideband services will primarily develop out of the development of multimedia end systems and their communications. In this connection multimedia means text, graphics, pixels, speech, audio and video in any combination. A typical application for this is all of the office communication including the production preprocessing of documents, where today the conventional forms of office communication will clearly undergo additional development from paper to electronics. The precondition for this development is not only the availability of suitable multimedia end systems (workstations, local networks, electronic archives), but probably more an overall production standardization of multimedia communication and a considerable improvement and simplification in the accessibility of the technology in the work place.

The Berkom test network originally served "only" the purpose of meeting the communications needs of the application projects. Meanwhile, however, it became clear that such a test network for the development of network technology can render invaluable service, because new technical installations can already be brought into practical use at the laboratory technology stage and, if need be, even with still limited reliability, and their performance capability can be tested. They are tested not only by Bit generators, but for real applications and by real users.

Conversely, it is possible for manufacturers and users of end systems, even before general use of a fully developed mass technology in the telecommunications network, to turn the new technology into a practical foundation for their development work. The aspect of network technology development is gaining importance for the Berkom test network, because the ATM transmission technique installed since 1989 in the test network is presumably the first installation in the world outside a laboratory to provide the opportunity to study the ATM transmission principle in a real application environment. Through the simultaneous availability of the STM nodes it is even possible to test these same application systems in the various wideband network variants, in order to get feedback regarding the effects of the various characteristics of these network types and the cost of the end systems.

According to present plans, the test run of the Berkom project will be completed at the end of 1992. However, it looks like the application-related activities begun with Berkom will be continued, because it has been confirmed that utilization of the telecommunications networks in the future must be evaluated and can also be prepared with a method such as Berkom.

Implement Overall Systems

It has turned out to be almost even more valuable that through this form of application-related research a network operator can acquire knowledge and experience in all fields that are affected by the telecommunications development and that interact. After all, the overall system does not consist only of the public telecommunications network, but also of the end systems, the applications and their organization.

It must be borne in mind, above all, that ultimately it is the user, the human being, who decides whether and how the overall telecommunications system will be used. He must therefore to a much greater degree become the starting point for the discussions than what is usually the case today. Projects such as Berkom and application-related research as a rule demand thinking in overall

contexts and permit the implementation of comprehensive systems and relationships of effect. The knowledge gained from this can provide a more secure foundation for DBP Telekom's decisions in many areas. This conclusion can be made today, two years before the conclusion of the Berkom project, and so can the statement that application-related research is a continuous task not only from the aspect of wideband communication.

Germany: Reconstruction of Eastern Infrastructure Increasing Tempo

91WS0252A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 19 Mar 91 p 8

[Article by Professor Karl Tetzner: "Efforts To Establish a Telecommunications Network Intensifying: Postal Service Has Switched 35,000 Lines to the New Federal States"]

[Text] Hannover, Mar 18—Many people in the previous FRG know from personal experience that the dismal telephone service in the five new federal states still has a long way to go. Although Telekom has established 35,000 interconnections between the previous FRG and the new federal states, the desolate state of the telephone network in these new states has improved very little; 40 years of neglect cannot be remedied overnight.

In the forum on telecommunications at the CeBIT in Hannover Helmut Ricke, head of Telekom, gave several examples of the almost desperate efforts at overcoming the difficulties in the new states. These efforts include both diligent long-term planning as well as stop-gap measures which make some old post-office officials shudder. Ricke explained a few basic problems. For instance, the postal service has to construct 2,000 buildings for new telecommunications facilities, and sometimes construction is almost impossible given the unsolved questions of ownership.

Switching containers can be set up more easily, however, gradual dismantling of these containers has to be included in the planning. Last year, the postal service was able to establish 100,000 new telephone connections which the GDR government had established for its own purposes, for the railroad and water systems and in particular for the chemical industry and the State Security Service. Ricke listed a total of 23 networks which are still operational, either as a whole or at least in part, including the extensive Russian military network. Efforts are made to use some of these networks for public service.

However, the problem with these attempts is similar to the problem posed by the many temporary solutions which are suggested again and again: Too many special installations do not fit into the general plan for the telecommunications future of the five new federal states. The question is whether to find a quick, but very expensive solution using costly stop-gap measures, or whether it would be better to show more patience.

Dr. Hans Bauer from Siemens described his company's efforts and pointed out that voice communication, i.e., the old-fashioned telephone, still is and will remain the workhorse. He mentioned one problem, namely the fact that the telecommunications traffic of the previous GDR was oriented primarily towards the East; connections to the Federal Republic were severely limited to allow for monitoring.

Dr. Bauer reported that Siemens is currently shipping ten percent of its telephone production to the new federal states and that approximately 7,000 employees are engaged in planning activities. A total of 25,000 Siemens employees are working in the new federal states. According to Dr. Bauer the availability of the packet switching network for data transfer by the end of this year using an X.25 interface is a lucky coincidence.

In 1988, Siemens had complete plans for installing the network in the GDR; however, implementation was prevented by Cocom regulations, so that these detailed plans are available now. Are there too few telecommunications technicians in the new federal states who could work together with Telekom? Ricke complained about the inflexibility of the local chambers of commerce and industry and the chambers of skilled trades.

Dr. Steyer pointed out that the large number of employees who had worked in this field in the previously state-owned enterprises should be utilized. Tyll Necker, Vice-President of the Federation of German Industries, explained the current situation. In 1989, there were 1.2 unfilled requests for a telephone connection in the GDR; more than 3,500 communities with a population between 100 and 3,500 did not have public telephone service. An Ifo survey among businesses showed that telecommunication ranks first on the list of requirements, ahead of road transportation and public administration.

According to Necker it was a lucky coincidence that the postal reform was getting under way shortly before the opening of the wall. This reform allows for much more flexibility and freedom with regard to organizational and regulatory questions. "The elephant is slowly getting underway." He feels that Telekom made great progress, however, the results are not noticeable yet, so that it appears as if not enough is being done.

Wilhelm Huebner, chairman of the Association of Postal Users, is not quite as positive in his assessment of Telekom. He feels that temporary solutions are very inexpensive and therefore justified, and he added that there are much too few East-West connections. According to Huebner, there are currently 27,000 connections (Telekom quotes a figure of 35,000). Some observers were asking: Why does the East-West connection work so well in the Hamburg-Schwerin area when it does not work elsewhere? Conclusion: There is a lot of Telekom bashing, but Telekom is still trying to do its best.

One thought-provoking observation was heard among the audience: Everybody says that the five new federal states urgently want to establish a great number of telephone connections. Today, there are 1.9 million connections, 0.5

million are to be added in 1991 and 1992, more than 1.4 million starting in 1994, and by 1997 a total of 9 million main lines are to be installed which would be about the same telephone density as that of the previous FRG.

However, experience has shown that the telephone density is a function of the GNP, and it will take a long time before the previous GDR enjoys the same level of affluence as the old federal states. Could it be that the telephone growth curves which look so good are much too optimistic? After telephone service started in the German Reich with the first exchange in Berlin in January 1881, it was not until 1920, i.e., 39 years later, that the first million subscribers was registered. As late as 1970, only one in four federal households had a telephone. Incidentally, as the 1.4 requests were slowly being filled, it sometimes happened that the applicant had passed away during the waiting period which could be as long as 14 years...

Deutsche Bundespost Telekom Pilot Projects Reviewed

91WS0340A Heidelberg NET—NACHRICHTEN ELEKTRONIK + TELEMATIK in German Apr 91 pp 131-133

[Article by diplomate engineer Gerd Tenzer, a member of the board of directors of DBP [Deutsche Bundespost Telekom], Bonn: "Competition of Architectures"]

[Text] In a series of pilot projects with the name Opal (Optical Access Line), DBP is testing specific fiber optic network architectures from various suppliers, with the stated goal of having the first low-cost FITL (Fiber in the Loop) serial systems in FTTC (Fiber to the Curb) and FTTH (Fiber to the Home) versions available within a few years and being able to buy them competitively. Undoubtedly, the task of reorganizing the telecommunications network in eastern Germany has also considerably reinforced DBP interest in early large-scale application. The Opal pilot project series is being supplemented at an early stage by pilot projects with current task definitions.

At the present time, what is under consideration are pilot projects with flexible (synchronous) multiplexers to supply major business customers and with SDH (synchronous digital hierarchy) rings in the main cable area, inserted add-drop multiplexers and connecting fiber-optic star topologies in a Fiber-to-the-Home version to supply business and private customers. Among the topologies mentioned, preference is for the double star topology, which must appear particularly familiar to the planners who are trained in handling star networks. This topology is basically judged to be easily handled and reliable for the future.

Characteristics of the Opal Pilot Projects

Opal No	Location	Start of Operation	Number of Participants	Switching Center	System Supplier	Topology	Remarks
1	Cologne	Jun 90	192	electrome-chanical	Raynet Corp	Bus	in operation
2	Frankfurt/ Main	Jul 91	about 50	Siemens EWSD	Raynet Corp	bus/splitter	city region (banking district)
3	Lippetal	Jun 92/ Jun 92/ Sep 92	≤ 4,500		Raynet Corp	Bus/splitter	3 expansion levels; specific construction styles
4	Leipzig	Jul 91	Private 100 Business 100	SEL Alcatel System 12	Siemens	double star	residential and business district
5	Cologne (Media Park)	Jul 91	Private 192 Business still open	Siemens EWSD	SEL Alcatel	double star	city region
6	Nuremberg	Jul 91	≤ 200	electrome-chanical	FAST (AEG, ANT, PKI)	double star	residential district
7	Bremen				Bosch Telecom	trunk line	alternative to Opal 3

Competition and Cooperation

The conclusion of a cooperation agreement with Raynet Corporation in July 1988 offered the first visible proof of DBP's FITL activities. Within the framework of the agreed cooperation, a system technology originally developed by Raynet for the U.S. market was to be correspondingly adapted to the demands of the DBP technology and be further developed from the aspect of cost-effective application.

The second step was taken with the all-European concept competition "Commercial Application of Fiber-Optic Technology in the Subscriber Field," initiated by DBP. This competition of concepts created a broader base for the intended intensification of the FITL activities by DBP.

The cooperation agreement signed with Raynet Corporation envisions up to three jointly undertaken pilot projects with varying objectives. The first pilot project (Opal 1) has been in actual operation since the end of May 1990. The second (Opal 2) will start actual operation at the beginning of the third quarter of 1991. A third pilot project (Opal 3) for wideband distribution service in rural areas is in preparation at the moment.

The concept competition is intended to:

- Be able to select the concepts for innovative fiber optic systems most suitable for DBP's purposes, and subsequently
- Be able to test those concepts which are judged worthy of realization and trend-setting in further pilot projects and thus
- Be able to come closer to the goal of obtaining competitive FITL systems for various application areas at an early stage.

The requirements formulated in the bid qualification were kept to a minimum, in order to obtain the desired broad overview. A total of 16 companies or consortia have subsequently presented alternative concept proposals and thus documented the very lively interest in the concept competition on the part of the companies.

The following concept proposals presented for fiber-optic systems, with the objective of providing the service/service combinations were:

- Wideband distribution service (general, in rural areas, in the area of trunk lines),
- Transmitted telecommunications services/fixed connections (analog and digital up to 2 Mbit/s, general and for business connections in the city region) and
- Wideband distribution service and transmitted telecommunications services/fixed connections

The proposals were evaluated by the middle of 1990 by the Central Office of Telecommunications Technology of the DBP. The evaluation of the concept competition resulted in a decision to undertake four additional pilot projects (Opal 4-7) and in parallel to take the first acquisition steps for those systems which have already been sufficiently tested and can thus be regarded as ready for large-scale introduction. The acquisition measures mentioned include fiber-optic systems, which can be economically used even today in comparison with conventional copper systems, in the field of connection lines for the wideband distribution network and in the main cable sector of the telephone network/IDN [Integrated Telex and Data Network].

Technical Details for the Opal Pilot Projects

Opal Pilot Project	Power Supply	Operating System	Coupler/splitter	Wavelengths Used	
				Transmitted Services and Fixed Connections	Wideband Distribution Services
1	central	System Administration Module (SAM)	flexible coupler	1,310 nm	1,310 nm
2	a) central b) decentral*	System Administration Module (SAM)	fused biconic splitter	1,310 nm	
3	a) central b) decentral* c) decentral**	video administration module (VAM)	fused biconic splitter		1,310 nm
4	decentral from participant		1:2 (2:2) 1:6	1,300 nm 1,530 nm	1,300 nm
5			1:16	780 nm 1,300 nm	1,310 nm (1,500 nm)
6	a) central b) decentral*		1:4 1:32	1,300 nm	1,300 nm
7					

* from participant ** from the energy supply company

Goals of the Pilot Projects

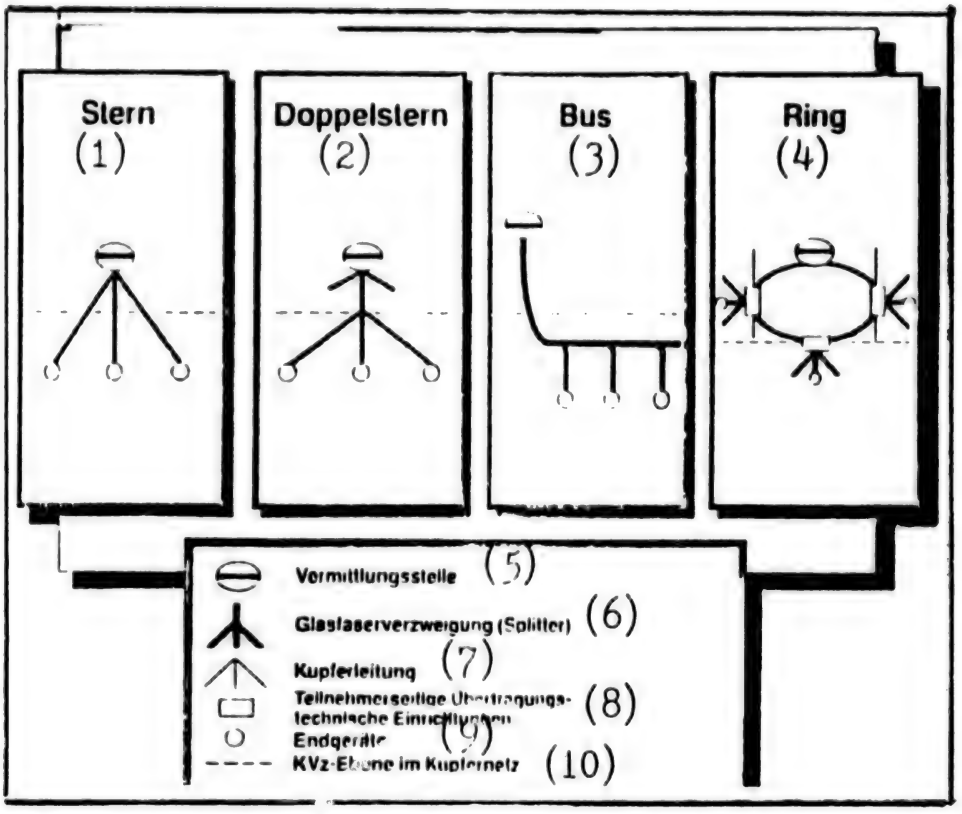
DBP's Opal pilot projects have a very complex overall goal.

Among other things, the pilot projects are to:

- Prove the feasibility of various innovative concepts,
- Supply basic knowledge about the performance and cost level which has been achieved in the field of fiber-optic technology or which might be achieved within a reasonable time frame, thus providing the necessary number of reference points for the specification/standardization of the desired infrastructure in the subscriber region,
- Bring about an early offering of low-cost fiber-optics systems which are capable of integration and which can optionally be upgraded for new services, in order today to supply diverse customer segments with accessible, appropriate combinations of services.

Special Conditions Taken Into Account

In the cooperation agreement concluded in 1988 with Raynet Corporation, two pilot projects with varying focal points were firmly agreed on and fixed with respect to their content, size and implementation period. In the Opal 1 pilot project, the bus topology developed by Raynet to supply 192 private participants with wideband distribution service and analog telephone connections is being used and studied in a test area in Cologne (see also the contribution on p 152 of this issue [not included]).



Topologies in the Subscriber Connection Area (Fiber to the Home)

Key: 1. Star—2. Double star—3. Bus—4. Ring—5. Switching center—6. Fiberoptic branch—7. Copper cable—8. Transmission-technical facilities on the subscriber side—9. End equipment—10. KVz level in the copper network

In the Opal 2 pilot project, Raynet Corporation is using a modified network topology to provide business subscribers with ISDN [Integrated Services Digital Network] basic connections/ISDN primary multiplex connections and analog telephone connections (POTS), and, respectively, connection possibilities for private branch exchanges.

Use of the bus splitter topology is the distinguishing feature of a further development of Raynet's system philosophy supported by DBP, a philosophy which promises to take the special conditions in the selected test region in Frankfurt City (banking district) particularly into account and furthermore opens up the prospect of a broadly applicable serial system which also meets complex requirements. It should also be mentioned that both pilot projects use an Stand-Alone version operating system (System Administration Module, SAM).

Over the last few years politicians and municipal representatives in Germany have increasingly demanded that thinly populated areas should also be supplied with radio and television programs.

This demand, which, for reasons of cost, it has not so far been possible to meet with the wideband distribution systems presently used in the DBP network, led to the conception of two additional Opal pilot projects, which primarily serve to develop a low-cost fiber-optic system for supplying the rural region with a wideband distribution service.

A positive outcome of the pilot projects would have the result that DBP could more economically supply areas which could not previously be reached, and by using the new system in densely populated areas as well, additional economic success could be achieved. The Raynet (Opal 3) and Bosch Telecom (Opal 7) companies, who have been given the task of completing the pilot systems, are approaching the solution of their tasks in two different ways.

The more extensive approach by the Raynet Corporation envisions using fiber-optic technology in the connection area, whereby the knowledge and experience gained in the Opal 1 pilot project can be applied to the design of the distribution network.

Bosch Telecom's approach makes use of fiber-optic technology primarily in the area of connecting lines, which, with respect to the structure of rural supply regions and by making full use of the performance capability of fiber-optic technology, is expanded in the distribution region. It is anticipated that both pilot

projects will supply significant knowledge for the future specifications of an extensive fiber-optic network.

Pragmatic Approach

In the most recent Opal 4-6 pilot projects, which will begin operation simultaneously in mid-1991, system architectures from various suppliers will be tested on the basis of nearly identical double-star network topologies in very different types of supply situations. For each of the projects, which are being carried out in Leipzig, in the area of the former GDR, in MediaPark in Cologne and in a residential district in Nuremberg, systems for a combined offering of transmitted telecommunications services/fixed connections and a wideband distribution service are being used.

The parallel undertaking of several Opal pilot projects marks a pragmatic approach by DBP, aimed at obtaining competitive fiber-optic serial systems in various application areas after about 1993/94. The geographical distribution of the pilot projects is to promote early accumulation of know-how for the organizationally active units, in the sense of the abovementioned purpose, and to support implementation of the anticipated serial systems.

TELECOMMUNICATIONS R&D

Hungarian Mobile Telephone Frequency Controversy Reviewed

Chronology of Events

91WS0357A Budapest COMPUTERWORLD/ SZAMITASTECHNIKA in Hungarian 28 Mar 91 pp 13-17

[Unattributed article: "Frequented Frequencies, or The Canossa of Hungaria-Elecom"]

[Text] Hungary needs a mobile radio telephone network for reasons beyond the lack of a sufficient number of installed lines. A catch-up program for this has been started with much energy, indeed with sufficient capital. Here also, of course, there will be a goodly number of managers "living" in their cars, from which they can telephone or fax, but it is not for them alone that there should be a struggle, before and behind the scenes, for the frequencies. Radio telephone—with a suitable infrastructural background and, primarily, with its related services—is also a matter vital to landline telephony.

Information provided here reveals that telephone deals were not "made in heaven." To begin, note that originally only Hungaria-Telecom made a bid for a frequency range which does correspond to the American frequency distribution but not to the Western European one. By building this radio telephone network, Hungary would have gotten somewhat less close to Western Europe.

Public radio telephone service began in Budapest on 15 October of last year—operated by Westel, that is by Magyar Radiotelefon Ltd. By the end of the year 3,000 subscribers had been connected and in the beginning of 1991 the network was expanded by another 3,000 subscribers. Since the capacity of the 450 megahertz band is limited (it is suitable for serving a total of about 50,000 stations) further development will be in the 900 band. By 1993 we could put 40,000 stations into operation on the 400 band. If Hungaria-Telecom had not gone to court, it could be doing business in this range already.

The Beginning; the Summer of 1989

Coopinvest, the BRG [Budapest Radio Technology Factory] and the Technika Foreign Trade Enterprise signed a cooperation agreement in the summer of 1989 for the purpose of creating a radio telephone network. On 22 May 1989 Coopinvest was informed that the Radio Electronics Headquarters of the Ministry of Defense had no objection to use of the frequency band designated for the Hungarian People's Army (a band of 28 megahertz extent in the 800 range). On the same day Coopinvest asked Minister Andras Derzsi (after reporting on the situation and the intent) for a permit exempting it from the Postal Law: To establish a closed stock company to create, operate, and further develop a national network; for the services of the network; for independent city and regional television broadcasting; and to provide telecommunications services on a leased satellite channel.

As a result of the request the Communications Main Department of the Transportation and Communications Ministry (Kohem) issued a preliminary use permit "not authorizing the beginning of concrete operations" for a frequency range covering a total of 58 megahertz. The issuing authority called attention to the conditional character deriving from the obligation for international coordination and provided information on the requirements pertinent to the preliminary plan to be submitted for coordination and on what had to be done in connection with tying in to the network of the Hungarian Post Office.

At a press conference on 9 June 1989 Coopinvest reported that "the Australian Bond Corporation Holdings Limited and Coopinvest had signed a preliminary contract for creation of a national cellular radio telephone system."

In possession of the preliminary permit Coopinvest informed the president of the Hungarian Post Office that "a stock company called Bond-Hungaria-Telecom was being formed to establish a radio telephone network" (13 June 1989).

An answer was received eight days later; it did not address the connection proposal—the Hungarian Post Office postponed this to a good bit later, on 3 October, citing the preparatory activities and the reorganizations then under way—but it did state that the Frequency Management Office, and the Kohem Communications Main Department were responsible for frequency harmonization, and that a description of the general conditions for tying in to the postal network had been delivered earlier.

So on this day the Kohem Communications Main Department gave Coopinvest a permit for activities "to be provided via a cellular radio telephone network to be realized at its own expense."

On 3 July Coopinvest asked the OMFB [National Technical Development Committee] for a 50 million forint contribution. As justification it noted, among other things, that:

—The total for an investment serving 50,000 subscribers would be 80-100 million dollars, which would be provided in its entirety by the Bond firm;

—The system would be created by a stock company the formation of which would take place with the agreement of the appropriate Hungarian government organs; and

—Combined network development activity would begin shortly, as a result of which the Hungarian participants would gain access to know-how.

The members of Hungaria-Telecom Ltd, formed with 1 million forints in base capital, were: Coopinvest, 10

percent; Technika, 10 percent; BRG, 10 percent; Centroinvest, 50 percent; Laszlo Kapolyi, 10 percent; and Zsolt Harsanyi, 10 percent.

In its preliminary plan Coopinvest described a system suitable for serving 150,000 subscribers. An accompanying letter stated that the system would be established with foreign capital, that an obligation to reinvest the expected profit would be undertaken, and that they were ready to join in the development of the national telephone network as well.

From the beginning there were critics of the plan in the ministry. Imre Bolcskei, deputy chief of the Communications Main Department, giving his opinion of the preliminary plan, noted that the organizational cooperation of the system and the postal network was still not clear, that the domestic and international agreements needed in the affected bands were still lacking, and that a position could be taken after the technical content was critiqued by the requested neutral forum. Gyula Partos, a ministry main department chief, noted that the proposal might have a good chance in the competition which the ministry would have to announce as soon as possible in the area of mobile telephony. At the same time there was an opinion in the ministry that building the system would lead to a monopoly situation, which spoke against adoption of the proposal.

At the request of the Kohem the Expert Committee of the OMFB debated the preliminary plan on 1 November 1989. At the meeting Zsolt Harsanyi, business director of Hungaria-Telecom, said that his firm was not trying to create a monopoly situation. According to the minutes of the meeting "no opinion was expressed which would have opposed the submitted project. The initiative represents progress in the interest of deregulation and the introduction of new technology."

The next day the minister received Zsolt Harsanyi, who reported on the business policy ideas of his firm. According to him by contributing to the development of the telephone network as a whole Hungaria-Telecom would like to "provide the minister and the government a business and political success which would win the ministry respect in a multiparty parliamentary democracy."

Shortly thereafter the ministry announced that in the interest of an accelerated development of domestic telecommunications it had given preliminary approval for a radio telephone system to be financed by Hungaria-Telecom, that a number of other bids had been received as well, thus it was obliged to propose a competition, and that the factors to be considered were being worked out. This showed that Telecom too was obliged to submit tenders.

Hungaria-Telecom took cognizance of all this, and then the ministry issued for it a permit pertaining to a system with a 50,000 subscriber capacity. An additional proviso guaranteed that having met its responsibilities Hungaria-Telecom would not be in a disadvantageous situation later vis-a-vis other organizations.

Is The Road Clear?

On 15 November Hungaria-Telecom requested the issuing of a frequency designation resolution for use of 890-898 and 935-943 megahertz, attaching the preliminary permits of the ministries of defense and internal affairs. Nine days later it submitted to the minister its expanded proposal for cooperation in the telecommunications development program according to which Hungaria-Telecom "as one of the representatives of the Hungarian state" would participate in all Budapest telephone developments.

A month later the ministry—which had started international harmonization in connection with use of the 900 frequency band—received negative letters from its own experts. The internal letters pointed out, on the one hand, that in order to judge proposals pertaining to development of telecommunications networks, it would be necessary to work out a telecommunications development policy and, on the other hand, that the Magyar Radiotelefon Company could probably satisfy the needs in the 450 megahertz range, that the role of the 900 megahertz band was at most a market building one.

So the answer was that the "clear road" was a deadend. The Kohem announced that it could not agree to the full or even partial use of a frequency band of 58 megahertz extent.

The basis for the decision was that the international harmonization could drag on until the end of 1990. Then a frequency distribution plan could be prepared, and this could be followed by a competition proposal. The Frequency Management Independent Department also raised professional objections; it noted that the preliminary plan did not describe the concrete equipment and system, thus the plan could not be correct.

In the wake of the rejection Hungaria-Telecom turned to the minister (21 December 1989) noting that HT had been working right along on the basis of the permits of 7 and 21 June, that it had submitted its preliminary plan on time, a plan which the OMFB jury "approved for realization," that the 2 November agreement had listed the conditions for issuing a permit pertaining to a radio telephone system, that the HT had accepted these and that it had signed a joint venture contract with the Bond CHL firm which could go into effect only if the HT got a final frequency permit by 1 January 1990.

On 4 January—not having received an answer—Hungaria-Telecom submitted an appeal to the minister. Its arguments were that the OMFB jury had approved the preliminary plan, that following this it had adhered to all the points of the agreement made with the ministry, or would undertake them as conditions for realization, that due to the drawn out international harmonization one could start with a Budapest regional permit.

that a competition was not justified technically because the requested band width could bear only one venture, and it would mean time lost too, that the preliminary plan had been prepared by recognized experts whose responsibility the enterprise would vouch for, that the work was being done on the basis of conversations the minister had had with the foreign partners, and that the participation of the Hungarian state in the joint venture had been assured.

In the Meantime (Or Marking Time)

The responsible main department of the ministry prepared a report in which it analyzed the antecedents, noted the contradictory legal situation which existed when the preliminary permit was issued, and the illegal nature of its issuance, and noted that the firm registration of Hungaria-Telecom might be illegal as well (if it contained activities belonging at that time in the sphere of a state monopoly). The report stated that when the preliminary permit was issued the intention of the ministry was to encourage rather than reject a constructive risk venture serving the public interest.

At the same time it stated that Hungaria-Telecom had failed to meet a number of prescribed conditions. It recommended (among other things) a clarification of the circumstances of the firm's registration, a definition as soon as possible of the concession conditions, a quick decision pertaining to frequency use, the publication of a competition and modification or withdrawal of the preliminary permit.

On 25 January deputy minister Bela Doros also summarized in a report for the minister the essential aspects of the situation. In his judgment the authorization, in accordance with what had gone before, of the activities of Hungaria-Telecom would seriously violate the interests of the country, would limit even in general the possibilities of competition and the giving of concessions. He pointed to the errors committed by the ministry which were the basis for the belief in the good faith of Hungaria-Telecom, and he recommended several compromise solutions.

Not much later (on 13 February) Hungaria-Telecom requested the personal intervention of Prime Minister Miklos Nemeth. It described the antecedents, said that it had satisfied every condition imposed upon it, that on the basis of this it had signed an agreement with the Kohem and had then signed a joint venture contract. It called attention to the Hungarian Post Office-US West agreement, which had not involved competition, and to the fact that the Hungarian Post Office had shunned the bid of Hungaria-Telecom. It noted that the joint venture contract prescribed for Hungaria-Telecom the winning of a frequency designation resolution for 600 channels by 31 January 1990, and that this time limit had been extended to 25 February.

At the request of the joint venture (19 February 1990) deputy minister of justice Tamas Sarkozy took a position in three questions (9 March):

— The HT justly requests a final frequency designation resolution.

— The Kohem is justified in requiring a competition, but the HT is not obliged to participate, and

— If the state organ breaks the agreement then action must be taken according to civil law.

On 22 February minister Andras Derzsi threw out the proposal of his deputy (to nullify the permit which violated the regulations and to institute new proceedings). The reasons for his decision were the urgent need for a mobile radio telephone service, the dilatory activity of the Hungarian Post Office in this area, without result and consuming resources, the advantages of the Hungaria-Telecom proposal, and the existence of the Hungarian Post Office-US West joint venture (Magyar Radiotelefon Ltd.) which thus creates a competitive situation.

The minister requested the publication of a competition within 15 days, bringing in outside experts. And he started an investigation to clarify the situation of the work of the Hungarian Post Office in connection with cooperation (tenders, etc.) and the lack of results.

On 6 March the Communications Main Department compiled the draft of an answer to be given—a rejection—to the appeal of Hungaria-Telecom. This called attention to the satisfaction of legal conditions and to making up the deficiencies established and held out the prospect of the invalidation of the preliminary permit as of 31 March.

Eight days later deputy minister Doros informed the minister that the Kohem Technical Development Main Department had completed the ordered investigation: it had prepared for nullification of the illegal permit and for publication of the competition.

In the meantime the Ministry of Industry took cognizance of the fact that the activity sphere of the BRG had been expanded by "4211—postal and telecommunications" activity and the Ministry of Defense had issued for the Kohem a position concerning the use of frequency bands and a schedule whereby they could be freed (13 and 14 March respectively).

Exchanging Notes in the Doorway

Since the minister had rejected the demand of Endre Csernak, chief of the Communications Main Department, that he receive in writing an instruction to withdraw the illegal permit and repudiate the November permit the secretary to the deputy minister forwarded such an instruction to the chief of the main department who (contrary to his own position) informed the director general of Hungaria-Telecom of the decision as a step carried out within the discretional sphere of the minister (26 March 1990). In his letter he stated that "the company does not have a frequency use permit", its

composition does not correspond to the legal requirements, and it has no agreement with an organization responsible for the national network concerning the technical and economic conditions for tying in to the national network. Thus the activity permit has lost its validity, but Hungaria-Telecom could try its mettle in the up-coming new competition proceedings.

The appeal of Hungaria-Telecom reached the minister dated as of 30 March. According to the appeal the original permit was a final one since "it was interdependent with creation of a radio telephone network and with offering a service", the HT had met the conditions of the preliminary frequency use permit and had kept to the agreement made with the Kohem, the capital share of the BRG meets the legal requirements, technical harmonization is under way and finalization of the frequency permit is needed for the agreement.

So Hungaria-Telecom requested a final frequency designation resolution, first for an extent of 26 and then for an additional 14 megahertz, and obliged itself to establish in these frequencies more than 50,000 stations only on the basis of a separate permit. It took cognizance of the requirement for international harmonization, but requested the permit for unaffected internal regions. Citing its good faith proceedings and its significant investments, it noted that "the foreign partner has the permits and documents which support the utility of the investment." Because of the weight of the legal and material consequences of rejection it requested a favorable decision out of sequence.

In the meantime, on instructions from the minister, deputy minister Bela Doros was conducting, at the end of March, discussions with the leaders of Hungaria-Telecom. He reported that the ministry was ready to provide 250 channels (6.25 megahertz) in the frequency band (800) to be released by the Ministry of Defense. Hungaria-Telecom rejected this because Motorola, the delivering firm, does not have standard equipment in the range offered.

Then Bela Doros compiled, on 2 April, for the minister, a draft of the decision (with force of law) to be given to the appeal. Among other things this pointed to the errors committed by the ministry and to the fact that a recognition of these made necessary the resolution of 26 March. It also rejected the demand of Hungaria-Telecom for reparations, since the cause of the possible expenses was the risk taken by the joint venture.

On 6 April he reported to the minister that publication of the competition would have to wait on the result of the international harmonization. He reported on the messages reaching him which threatened court action and scandal, threats which he considered groundless. On this day also the minister received a translation of a letter from the respected firm Tricapital Ltd., with headquarters in England, which held out the prospect of punitive counteractions.

— The Bond Corporation (from which Contel Cellular was taking over the rights) would sue the Hungarian government.

— The trial would alarm investors, delay communications developments, and cast light on the advantage received by US West without competition.

J. S. Nounou put the suit value in the neighborhood of 100 million dollars.

On 10 April (without having received an answer to the appeal and referring to the events of the preceding days) Hungaria-Telecom sent two letters to the minister. The one informed him that the firm would withdraw its appeals if the ministry would issue a final designation resolution for operation of radio telephones in the 890-898 and 935-943 megahertz ranges; would "guarantee operation" in the 840-845 and 885-890 megahertz ranges after they were freed; and would issue a certificate for service activity. In this event it was ready to forget everything which had gone before. In the other letter it took cognizance of the rejecting decision of the ministry and withdrew its appeals (unconditionally). In regard to the "antecedents" it asked to be issued frequencies sufficient for a 50,000 subscriber national analog radio telephone system and service rights in accordance with the legal conditions.

Endgame

On 12 April the minister signed two draft letters with almost identical text. In these he summarized the essence of the thinking of the ministry. In one he designated for Magyar Radiotelefon Ltd. the 450 megahertz range and in the other he designated for Hungaria-Telecom the 890-898 and 935-943 megahertz ranges, for radio telephone system purposes. The formulation of the requirements were essentially identical for the two firms; he gave to the Frequency Management Institute the right of defining the detailed conditions pertaining to use of the designated frequencies. In the two letters the minister called on the two undertakings to request a concession, and he designated the conditions for granting a service concession as follows: The Enterprise Court decides whether the composition and activity of the company correspond to the laws; a preliminary technical, financing and service plan pertaining to the system is prepared; and the foreign financer shows suitable bank guarantees.

The minister referred to the unclosed nature of the regulation of the concession authorization and listed a few essential conditions to be expected. He noted that "fees and securities must be paid for the concession, the sum of which and when due will be determined in the concession—in agreement with the National Price Office."

Referring to the two draft letters he told his deputy that a hard conditions system ensuring a competitive situation had been prepared, and he requested immediate

action to issue the frequency designation resolutions, with an effective date of 13 April.

On the 13th deputy minister Bela Doros reported that he could not carry out the instructions; in his opinion a frequency designation resolution was possible only after the issuing of a concession permit and the meeting of other preconditions (representing an expansion of the sphere of competition), probably after 30 June 1990. He pointed out that providing the 890-895 megahertz frequency range sould be enough for Hungaria-Telecom for a system built for 50,000 subscribers.

The deputy minister stated that a decision must be made now primarily in the question of connection to the digital paneuropean system (earlier the conditions for this decision were lacking), and that a competition could be announced. So he did not recommend that the minister's two letters should be sent out.

On 17 April Andras Derzsi did send to the directors of Hungaria-Telecom Ltd. and Magyar Radiotelefon Ltd. the letters which differed only in the data for the freqeuncy bands intended for designation and which called for a request for a service concessio n. The conditions system communicated was essentially identical with that in the draft. In the interest of symmetrical treatment the letter addressed to Magyar Radiotelefon Ltd. also offered the 898-906 and 943-951 megahertz bands and, adjusting to the wording of the Hungaria-Telecom affair, created the impression that Magyar Radiotelefon Ltd. had been a party to the "exchange of letters concerning frequency designation." Both letters stated that in agreement with the addressees he regarded "the still open questions brought up in earlier correspondence to be answered."

The next day Hungaria-Telecom receipted the minister's communication and reported that on this day it had begun, jointly with the foreign partner, to work out the technical plans.

On 19 April the minister sent copies of the two letters (as an option permit) to representative Attila Zsigmond, who on 27 February had turned to the ministery with a question in connection with radio telephone systems. He stressed that the conditions were identical and very strict and that the systems would not be obstacles to joining the paneuropean digital systems. On the same day the minister received a letter from the Telecommunications Research Institute (TKI). In it the TKI requested a frequency designation in the 900 band for a mobile radio telephone service (to be realized by bringing in American capital and peak technology) compatible, as of 1992, with the paneuropean system, and it requested acceptance of its intention to participate in a possible competition.

The Kohem Communications Main Department informed the Enterprise Court that Hungaria-Telecom had not received a general permit for postal and communications activity. The company had taken cognizance of the fact that it had been informed about the lack of the legal and technical conditions. So the Kohem requested the Enterprise Court to erase the pertinent registration (24 April 1990).

The Frequency Management Independent Department prepared an answer, as instructed by the minister. In it the minister provided information about his earlier decisions and stated that a competition would be announced in the remaining bands (906-915 and 951-960) after they were freed. In a note attached to the draft answer the chief of the department stated that he had been informed indirectly of the designation without competition, that for professional and moral reasons he could not agree with the minister's action and that he saw no explanation for the haste (26 April). On 25 April the minister sent to the director of the Hungarian Telecommunications Enterprise a copy of the letter written for Magyar Radiotelefon Ltd. He sent copies of both letters to deputy minister Bela Doros and requested acceleration of the international harmonization and of the domestic measures due to be taken.

The 93d International Commercial Counsellors' Work Group informed the minister about its interest in the creation of radio telephone systems and asked that the ministry provide authenticated information about its own conditions system (also to clarify rumors which were gaining currency). An independent experts' study of ENTAS Ltd., ordered earlier, arrived according to which the question of mobile networks should not be handled independently of the development of the existing public network; the development of the analog and digital systems could be adjusted to one another, indeed their parallel development could not be ruled out; analog systems are now capable of satisfying the needs, introduction of the digital system would not be accompanied by a substantial expansion of service; and there is a need to work out as soon as possible a long range frequency management strategy worked out publicly on a professional basis.

On 4 May Zsolt Harsanyi, business director of Hungaria-Telecom, was empowered by the members of the corporation to discuss the creation of a joint venture and to sign the joint venture contract. Those signing were: BRG (Sandor Bognar), Technika (illegible), Centroinvest (Zsolt Harsanyi and T. Toth), Coopinvest (Zsolt Harsanyi) and System Consulting (Laszlo Kapolyi).

On 8 May a bank guarantee arrived at the request of Hungaria-Telecom: The Chase Manhattan Bank gave witness to the financial solvency of Contel. On the same day came a statement by Contel Cellular in which it expressed its readiness in regard to creating a joint venture, in recognition of the conditions contained in the letter of the ministry. It was ready to accept these, and it provided information on the technical philosophy for the development. It was ready to accept broad obligations in the technical field if it got unlimited access at an acceptable price to the network of the Hungarian Telecommunications Enterprise, the current COCOM

[Coordinating Committee for Export Control] limitations ended, and there was an international frequency harmonization.

It also described its plans pertaining to competition among shippers and was ready to adhere to all prescriptions in the interest of obtaining the necessary operational permits. It summarized the financial elements of the concession requirement (even indicating an entry fee of 1,270 dollars). Citing the development policy guiding principles of the government and conversations conducted with officials of the ministry, it also made a proposal relative to national network development tasks and was ready to compete in this area with the Hungarian Telecommunications Enterprise. It promised far-reaching adherence to legality and open business conduct.

On 10 May Hungaria-Telecom submitted to the minister a draft of the concession contract and a statement by Contel Cellular accepting the concession conditions, in which Contel offered to submit to the ministry a realistic feasibility study after becoming acquainted with additional data. It also reported that Hungaria-Telecom had guaranteed to the BRG, at the Enterprise Court, a 51 percent majority share. It requested acceptance of the contract within a short time.

The minister and the director of Hungaria-Telecom signed the concession contract dated as of 10 May 1990. On 23 May Andras Derzsi issued a concession permit for Magyar Radiotelefon Ltd. The content of this was more concrete and differed in many respects from the Hungaria-Telecom contract. The formulation of the obligations was more precise; signatures of two directors of Magyar Radiotelefon Ltd. appeared on the document also, although the permit was issued by a unilateral decision, and it does not contain the conditions of the authorized party as formulated by him.

An Extension or a Tabula Rasa?

The Telecommunications Council, created in the spring and made up of enterprise representatives and government telecommunications experts, debated, on 11 June, the two documents issued for radio telephone networks (the Hungaria-Telecom concession contract and the concession permit of Magyar Radiotelefon Ltd.). The Council found that the issuing of the two documents was suitable for a discrediting of the concept of a concession so it would be useful if the minister were to distance himself from them; the issuing of the permit fell outside the sphere of authority of the minister on the basis of prior legal practice; the signature was not a matter of necessity, indeed a competition constraint existed on the basis of a public promise; the conditions accepted by the requestor were only apparently severe ones, the obligations falling on the giver of the concession were not advantageous and made the undertaking risk-free for the provider of the service; the grantor of the concession did not take into consideration the viewpoints pertaining to preparation for granting a concession as formulated by the two sister ministries (the Trade Ministry and the Ministry of Industry). So the Council recommended a legal review of the permit and the contract, considering action up to a withdrawal, with consideration also of the possibility of a reparation obligation.

A spectacular withdrawal could be well justified by the change in government, since the documents were signed by a managing minister acting with unclarified authority, and such a step could even bring an improvement in domestic and foreign good will. Even if an informal reconciliation seemed best there had to be a review of the procedural system.

On 22 June the ministerial college debated the questions surrounding the radio telephone systems—also with regard to the conditions system for World Bank loans.

In a letter four days later, the Ministry of Transportation and Communications informed the directors of Hungaria-Telecom and Magyar Radiotelefon Ltd. that an investigation had begun in the matter of the radio telephone agreements. In his answer (2 July) the director of Hungaria-Telecom offered the opinion that the investigation did not affect the concession contract as a unilateral change could not be effected. So one could not count on the possibility of a change.

Hungaria-Telecom, in a letter, informed Csaba Siklos, the minister of transportation and communications in the new government, of the unworthy efforts of its business competitors, of the bureaucratic obstacles and of the behavior of Hungaria-Telecom, characterized throughout by good will and a readiness to undertake conditions of unexampled severity. It informed him that the expenditures thus far came to several million dollars or several hundred million forints and that the application of 15,000 subscribers could be taken as certain. The director requested, not only in the name of his honestly obtained rights and opportunities but also "in defense of the economy of the country," a final conclusion to the case, and he was willing to have full publicity. This was urgent because a month of lost time "could ruin all the activity of the company" and could give the other affected system an advantage which could not be overtaken. The director attached to the letter documentary material connected with the formation of Hungaria-Telecom.

Since May 1990 Hungaria-Telecom had been advertising its system widely, was accepting applications and had signed agreements, taking in 80,000 forints in entry fees. It provided information about the formation of Contel-Hungaria.

Distributed and Designated?

By the beginning of August 1990 a committee formed in the ministry—consisting of outside experts not involved in the radio telephone affair—had completed its investigation and submitted its report to the new minister. The report found that a number of illegal steps had been taken in the matter of radio telephone authorization, on

the part of the ministry and of Hungaria-Telecom, and on the basis of legal opinion the concession contract could not be regarded as valid. It regarded as absolutely necessary an adjustment aimed at adhering to the regulations, disclosing the earlier errors and making them public.

The committee saw essentially two possibilities for settling the situation as it had developed: either invalidate the contract signed on the basis of legal violations which had taken place along the way—creating a sort of tabula rasa—and announcing a new competition which fit into the ministry's telecommunications policy; or—taking cognizance of the past antecedents—seeking a compromise solution. As part of the compromise Hungaria-Telecom-Contel would get a permit for 5 megahertz of frequencies with new conditions, and there would be a competition for the remaining frequencies.

But this compromise solution would probably have the consequence of having future players on the Hungarian mobile telephone market appearing for designation, for assignment of the frequencies available for this purpose. Minister Andras Derzsi had promised frequencies in the 900 megahertz band not only to Hungaria-Telecom but also to Westel. So if Hungaria-Telecom got a concession in this range without competition, within the framework of a compromise, then Westel also could justly demand the frequencies promised to it in the 900 range. Since it is very likely that the market for a mobile service can, for the time being, not bear more than two providers this would effectively divide up the market and the frequencies. And this solution would sharply contradict the obligation publicly undertaken and constantly represented since 1989 by the professional staff of the ministry in regard to other large Western firms and domestic bidders wanting to participate in mobile telephony, namely that following suitable regulatory preparation the firms making the best offers would be selected by open international competition in the 900 megahertz frequency band.

On the basis of the committee's report Csaba Siklos rejected compromise and during August 1990, he invalidated the contract signed by his predecessor, and informed the director of Hungaria-Telecom of this in a letter. The reason for the nullification was the illegal nature of the contract and the fact that at the time it was signed Hungaria-Telecom Ltd. did not as an entity meet the legal conditions then in effect. At the same time the minister withdrew the promise given by his predecessor to Westel in regard to the 900 megahertz band.

At the same time the minister also decided that a competition for the mobile telephone service to be offered in the 900 megahertz band must be announced as soon as possible; in the wake of this the ministry could begin professional preparatory work on the tender. The following communique appeared at the beginning of October 1990 concerning the decisions made by the minister:

Statement in the Matter of the Radio Telephone

"In the recent past a number of articles have appeared in the Hungarian and international press in the matter of authorizing the creation of radio telephone systems, articles reflecting various positions and indicative of contradictory expectations and motives. In the interest of clarifying the situation and of providing appropriate information to future radio telephone providers and subscribers wanting to make use of these services the Ministry of Transportation, Communications and Water Affairs considers necessary the following announcement:

"Andras Derzsi, the former minister, signed a concession contract with the Hungaria-Telecom company on 10 May 1990 concerning establishment of a radio telephone network operating at a frequency of 900 MHz and concerning the providing of a service. However, an expert committee created on the basis of a commission from the new minister, Csaba Siklos, and bringing in outside experts, has pronounced this contract invalid, because at the moment of signing the contract the Hungaria-Telecom company did not meet the legal conditions in effect giving the right to provide such a service. Thus the contract did not come into existence in a valid way. In addition the company does not have and never did have the frequency permit needed to make the contract valid. The new minister informed the director of Hungaria-Telecom of all this in his letter of 22 August 1990.

"The Ministry of Transportation, Communications and Water Affairs intends to announce an open international competition for establishing a radio telephone system operating at a frequency of 900 MHz and for providing such a service. Hungaria-Telecom or the joint venture established by it is expected to make a bid in this competition, insofar as this corresponds to the laws in effect. The announcement of the competition will take place during October 1990 following a ministerial decision pertaining to the band use of the frequencies. It is the intention of the Ministry that a new monopoly should not arise in the area of radio telephony, or that such a monopoly should be liquidated in such a way that several companies, competing with one another, should offer such telecommunications services."

From the Competition to the Court

On 30 October the Ministry of Transportation, Communications and Water Affairs (KHVM) published an open international competition for the winning of two permits. One permit is in the 890-898 frequency range and the other is in the 898-905 megahertz range—valid until 1992 only in the area of Budapest—to establish a mobile telephony network and offer services thereon. The future holder of the permit in the lower frequency range can start service at the lower 5 megahertz frequencies by building up an analog system, but later he must gradually shift to a GSM [satellite] digital service. According to the tender the provider of the other service—for the time being in Budapest—must build up a GSM digital system

ensuring connection to the paneuropean network. The competition documents define in detail the technical, economic, and commercial-financial conditions pertaining to building up the network and providing the service. The competition invitation announced for November 1990 a prebid conference for those wishing to participate and stated that the competition would be judged and the winners chosen by January 1991.

Shortly after this announcement, in November 1990, Hungaria-Telecom filed a suit against the KHVM in regard to the validity of the contract signed earlier. In its judgment of 7 December 1990 the Capital Court, judging essentially for Hungaria-Telecom, pronounced the earlier contract valid and regarded only some details thereof as nullified.

The KHVM submitted an appeal against the judgment to the Supreme Court and simultaneously postponed the announced tender conference until the Supreme Court renders a decision on the appeal. According to our most recent information, the Supreme Court has set a discussion of the appeal for the end of March 1991.

Legal Aspects

91WS0357B Budapest COMPUTERWORLD/ SZAMITASTECHNIKA in Hungarian 28 Mar 91 pp 18-19

[Unattributed article: "Document Extracts; Report on the Concessions for Public Radio Telephone Networks in Hungary"]

[Text] "Did he not know, who created the cleft, what he did with his right hand, and what with his left?" (Babits, "The Book of Jonah")

Minister Csaba Siklos issued a directive for the study which constitutes the basis for the following report on 22 June 1990. He did so on the basis of the following considerations:

— Some of the last decisions of Andras Derzsi, the minister who left office at the end of May, were made under the pressure of time and were embedded in the value system of the period prior to the change of system;

— The transformation of the legal system (which involves ownership of and trade in goods not earlier considered as property) is being dragged out, the acquisition of rights and the transfer of true countervalue for them may become separated from one another, preventing this is especially important in the case of national treasures;

— In the interest of producing and of making optimum use of resources for the telecommunications development program the conditions system for the development of subareas with significantly different profitability must be harmonized.

Antecedents

The capacity shortage of the public landline telephone network, the swiftly increasing and differentiated needs of business life and the above average profitability of mobile systems creates in Hungary a very strong incentive for the creation of mobile radio telephone networks. The Hungarian Post Office has dealt with such plans since the middle 1980's and since 1988 more and more entrepreneurs have appeared with developmental proposals. The majority of them were aware that a competition proposal could not be expected before the development of a frequency management concept, the implementation of international agreements, and the creation of legal frameworks. There were, however, two exceptions.

During 1989 one of the legal successors of the Hungarian Post Office, the Hungarian Telecommunications Enterprise which was being organized, developed an earlier contact which had expired due to COCOM restrictions. Making use of the possibility given in its sphere of authority for access to a frequency use permit without competition it created, with the participation of the American U S West, Magyar Radiotelefon Ltd. This company began to develop a radio telephone system around 450 megahertz in a range about 4 plus 4 megahertz wide.

Coopinvest, the Technika KV and the BRG (from the fall of 1989 this meant Hungaria-Telecom Ltd. as transformed by them) undertook the risk accompanying the uncertain situation and began development, requesting preliminary, conditional permits. By the fall of 1989 some disputed questions had been resolved but the laws needed to reorder matters had not been passed. For this reason, at the end of 1989, the ministry ruled out finalizing the permits received by Hungaria-Telecom and dismissed their appeals at the beginning of 1990.

The Legal Status of the Contracting Parties

It is the unanimous conclusion of the legal opinions prepared within the framework of the investigation that the Kohem (and the minister personally) was not entitled to sign a concession contract. The legal status of Hungaria-Telecom did not meet the legal requirements (none of the legal successors to the Hungarian Post Office was a member of the corporation, according to the data of the Enterprise Court the share of the state property did not reach 51 percent and not one of the members had the necessary service provision permit). Thus the invalidity—even null nature—of the contract can be pronounced with all certainty.

Since the Kohem had acted illegally, this is above dispute, a reparations obligation could be possible. The magnitude of this would depend on a determination of the culpability of Hungaria-Telecom and, in the case of others affected (Contel Cellular and the subscribers), of their own risk, reparations obligations and actual harm.

Technical Content and the Content of the Contract

It appears unambiguously from the contract as a whole that Hungaria-Telecom, without capital of its own, obtained the frequency use right from the Hungarian state (without immediate payment of a single sum fee) and was ready to sell the service authorization it felt it had to serve as its share in a joint venture the creation of which was a function of precisely the ownership of these rights. The contribution of the foreign partner provided the technical and material foundations in this joint venture.

It is a false assertion according to which the contract guarantees extraordinary advantages to the Hungarian side. On the contrary, there are very many disadvantageous conditions. The great majority of the disputed questions are not of a technical nature (or are so to only an insignificant degree). Professional opinion is divided as to when and at what cost the building of analog and digital systems is justified, whether, hindering one another or building on one another (tied together), they could be temporary or lasting elements of telephone culture—and the lines of this debate spread to broad professional public opinion and they change in time. The investigation could have evaluated the various views in an unbiased way only in the light of a developed telecommunications strategy which had matured through debate. Lacking such a strategy it could not turn to this sphere of questions.

The timing of certain developmental steps represents an exception in this regard. The system of Magyar Radiotelefon Ltd. started earlier, but in a frequency band and in such a narrow range that there are in general no professional doubts about the lack of technical conditions for competition. The question is not judged uniformly by professional public opinion in the 900 megahertz range either, whether within a foreseeable time it is useful or even permissible to build analog systems in a broad frequency range or whether bands must be reserved for digital technology and broad competitions should be announced, taking into consideration the gradual freeing of frequency ranges. The report does not take a position in this debate.

The Concession Permit

Since 1988, the Hungarian Post Office has had a frequency designation resolution for a public radio telephone network in the 450 megahertz range. In the summer and fall of 1989 it applied to the Kohem for additional designations in the 800 and 900 megahertz bands—without success. The association contract for Magyar Radiotelefon Ltd.—the joint venture of the Hungarian Post Office and US West—was signed on 4 December 1989; the investigation found no cause for doubts in regard to its legal status.

The legality of the concession permit issued for Magyar Radiotelefon Ltd. can be disputed in the same sense as the contract, from the side of the authorizing party. In character it is a permit, in it only the grantor of the concession formulates conditions, those signing for Magyar Radiotelefon Ltd. state that they are aware of these.

Nor can one doubt the right of the Hungarian Telecommunications Enterprise, as a legal successor to the Hungarian Post Office, to provide a service. The basis of the charges involving the role of Magyar Radiotelefon Ltd. (the charges are sometimes only allusions) is thus essentially the fact that it came into being under not purely competitive conditions.

Hearings

In the interest of clearing up the tangled interconnections, which could be found only fragmentarily in the written documents, hearings were requested with a few people who had played key roles in the course of the events. The purpose of the hearings was to learn the personal motives and to show that the investigation

— was striving to show the situation without prejudice;

— wanted to reach the broadest clarification of the questions;

— did not recoil from introducing contrary conceptions; and

— was seeking possibilities for a constructive solution.

The request for hearings was accepted and so Endre Csernak, Andras Derzsi, Bela Doros, Gabor Gyulai, Sandor Gyurkovics, Zsolt Harsanyi, Laszlo Kapolyi and Jozsef Pete contributed to the results of the investigation.

Conclusions and Recommendations

It follows unambiguously from legal considerations that pronouncing the concessions (both contract and permit) null or invalid is, on the one hand, a natural possibility and, on the other hand, of fundamental interest to legality. From the viewpoint of the Hungarian legal system, which wants to approach the norms of international competitive practice, not a single irregular situation can be tolerated and accepting the effect of a precedent which violates concession principles cannot be permitted. At the same time, restoring a clear legal situation does not mean a solution from the following viewpoints:

- The legal environment necessary for issuing a clear concession corresponding to international custom is still lacking, when telecommunications and concession laws will be passed is uncertain, the principles and content of these are not yet cleared up in every respect;
- A competitive situation does not come into being automatically, the ministry declared an intention to publish many times and it has work materials but there is no finished tender documentation; according to expert estimates this could be published no sooner

than the beginning of October (and due to the lack of the cited legal environment one can imagine only a competition announcement which is open with some of the conditions again being supplemented by state administrative or governmental decisions);

- Declaring the concession permit to be null would not affect the monopoly situation of Magyar Radiotelefon Ltd., the technical basis for that is in the 450 megahertz range and this step supports the contrivance of a modus vivendi;
- It is not possible today to estimate reliably the moral and material damage (and thus the material burden of a possible suit) to Contel Cellular, Hungaria-Telecom and other interested parties;
- The weight of the arguments (serious or demagogic) castigating the further delay in improving telephone supply and the governmental administration limiting free enterprise may prove comparable with the legal, ethical, economic, etc. arguments which may arise in connection with a case which has turned into a wider bed in the course of debate.

Nor can the future behavior of the affected parties be measured with full confidence. One might count on uncertain but probably vigorous counter steps from Hungaria-Telecom; one does not know the degree to which Contel may want to deviate from the position of its joint venture partners but it is probable that it attaches to a presence on the Hungarian market an interest extending to acceptance of a serious, real compromise.

A number of other questions may arise if, in possession of credible data, one could weigh the legal status of the joint venture, the reality and source of the capital shares—at present one can only speculate. So in taking a position the ministry is certainly justified in leaving open the possibility of future agreements, even if the government resigns itself to "restoring order" in a way which may come to trial. We describe in detail four of the strategies which might be considered; there are numerous common steps in versions A, B, C and D and naturally one can imagine other combinations of them.

A. A Position Committed to Competition, Even Accepting a Trial

1. Judging the concession grant and the activity of the people involved therein; distancing oneself from it; making public the errors, irregularities and thoughtless acts committed on all interested sides, trying to be complete so as to rule out the possibility of future "disclosures."
2. Announcing the null (or invalid) nature of the concession contract, withdrawing the concession permit, with recognition of the consequences of a possible trial (the statements pertaining to the two concessions could be separated, but in this version this is not advisable).
3. Announcing an intention to bring people to account.
4. An appreciation of the well-meaning and constructive efforts of the partners who lose the concession.
5. Public formulation of the ministry's basic principles for competition and granting concessions.
6. Announcing the intention to publish a competition for entrepreneurs interested in establishing radio telephone systems in bands to be designated within the 890-915 (935-960) megahertz range.
7. A comparison of the damage and disadvantages accompanying the halting or modification of developments under way with the advantages attained by virtue of the decision.
8. Preparing for the legal remedy or reparation steps to be expected from those affected.
9. Developing and conducting the authorization procedures needed for operation in the 450 megahertz band by Magyar Radiotelefon Ltd.

B. A Pragmatic Position Committed to Competition

1. Judging the concession grant and the activity of the people involved therein; distancing oneself from it; making public the errors, irregularities and thoughtless acts committed on all interested sides, trying to be complete so as to rule out the possibility of future "disclosures."
2. Announcing the null (or invalid) nature of the concession contract, withdrawing the concession permit, with recognition of the consequences of a possible trial (the statements pertaining to the two concessions could be separated, but in this version also this is not advisable).
3. Announcing an intention to eliminate the errors and deficiencies, an appreciation of the well-meaning and constructive efforts of the partners losing the concession.
4. Public formulation of the ministry's basic principles for competition and granting concessions.
5. Announcing a narrow, short time limit, by invitation competition in the 890-895 (935-940) megahertz band, with prior assurance of the legal nature of the ministerial conditions, making public a clear procedural system.
6. Initial steps to modify the postal law (to broaden the restrictions connected with the ownership ratio and operational monopolies).
7. Developing and conducting the authorization procedures needed for operation in the 450 megahertz band by Magyar Radiotelefon Ltd.

C. A Position Seeking a Compromise by Special Procedures But Open to Competition

1. Judging the concession grant and the activity of the people involved therein; distancing oneself from it; making public the errors, irregularities and thoughtless acts committed.

2. Announcing the null (or invalid) nature of the concession contract, withdrawing the concession permit.

3. Announcing an intention to eliminate the errors and deficiencies, an appreciation of the well-meaning and constructive efforts of the partners losing the concession.

4. Public formulation of the ministry's basic principles for competition and granting concessions.

5 Conditionally granting to Contel-Hungaria the 890-895 (935-940) megahertz band (based on prior approval by the Council of Ministers), initiating harmonization discussions to develop new, balanced and clearly formulated conditions.

6. Emphasizing openness in regard to expanding the radio telephone systems, announcing the intent for open competition in the ranges to be gradually opened in the 895-915 (or 940-960) megahertz band.

7. Developing and conducting the authorization procedures needed to operate in the 450 megahertz band by Magyar Radiotelefon Ltd.

D. A Position Seeking an Informal Compromise

1. Evaluating the legal uncertainties surrounding the granting of concessions, justifying the review in light of the contradictory conditions of the transitional period.

2. Announcing an intention to eliminate the errors and deficiencies, an appreciation of the well-meaning and constructive efforts of the partners losing the concession.

3. Initiating new discussions within the framework of harmonizing the concession documents, with the intention of eliminating their irregularities granting concessions.

Budapest, August 1990

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